

JUTE IN BENGAL

IV

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Agricultural Chemistry (in Bengali)
Cotton Cultivation (in Bengali)

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PREFACE

This book was written a full year ago, but my frequent absence from Calcutta, on duty, has delayed its publication.

Jute is one of the most important crops in the two Provinces of Bengal and Eastern Bengal and Assam, and a very valuable asset of the Indian Empire. But owing to the abnormally high prices of food grains during the last three years, due to short harvests in many parts of these Provinces, the landless middle and poorer classes who are really feeling the pinch most, have been loudly complaining against the cultivation of jute, as this crop is said to be responsible for this unusual state of things. I have endeavoured in these pages to persuade my readers that high prices have little or nothing to do with the cultivation of jute, but that, on the contrary, the growers and dealers of jute, have in fact, been materially benefited by the extension of its cultivation, and that people have been greatly relieved of the pressure which would otherwise have been more acutely felt by them.

As an Inspector of the Bengal Agricultural Department, I have been closely connected with the cultivation of jute for over fourteen years. It may not be out of place to mention here that in 1898, I started an enquiry regarding the qualities of the various races of jute grown in Backergunj (Chapter XLII.) On receipt of my report which was forwarded to him,

Sir George Watt, then Reporter on Economic Products to the Government of India, desired that the Department of Agriculture, Bengal, should make in other districts similar enquiries regarding the races of jute. Thereupon the Hon'ble Mr. P. C. Lyon, C. S. I., the then Director of the Department of Land Records and Agriculture, Bengal, very kindly entrusted me with this work. In the meantime in 1901 the Calcutta Baled Jute Association had addressed the Director of Land Records and Agriculture, Bengal, on the subject of the deterioration of jute and asked for assistance in connection with the question of improving the qualities of this fibre. As a result, field experiments were undertaken at the Burdwan Farm under the guidance of the Inspector General of Agriculture in India. On the recommendation of Mr. J. W. Mollison, M. R. A. C., the Inspector General of Agriculture in India, Mr. S. L. Maddox I. C. S., the then Director of this Department, was pleased to put me in charge of the Jute Experiments for the first four years commencing from 1902. The portion of this book which deals with the cultivation of jute crop will, I have every reason to believe, be found useful to all jute growers, European and Indian.

In connection with my duties I have had considerable opportunities of dealing with many jute houses. I am specially grateful to Mr A. P. Ker of Messrs P. M. Gillan and Co. who favoured me with some notes from which I have written the chapters on "Commercial Classification," "Baled jute" and "Loose Jute." The

various statements regarding yield, exports, prices etc., are based on Government reports and Mr. H. C. Bose's statistics. This portion of the book will, it is hoped, be found of interest and value to the trade.

Part IV which embodies the labours of many eminent official experts, will, I am sure, be found very interesting to all.

In Chapters II and XX I have freely quoted from Sir George Watt's invaluable "Dictionary on Economic Products of India." Mr. D. N. Mukerji, M. A., M. R. A. C., Assistant Director of the Bengal Agricultural Department, has very kindly read through the manuscript (Parts I and II) and made many valuable suggestions and additions.

To all the authorities, from whom I have received help in the compilation of this work, I owe a debt of gratitude.

DEPARTMENT OF AGRICULTURE, BENGAL,

Calcutta, March, 1908.

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N. C. C.

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JUTE IN BENGAL

PART I—INTRODUCTORY

CHAPTER I

OBJECTIONS TO JUTE CONSIDERED

A mischievous agitation has, of late, been set on foot, in some quarters, against the cultivation of jute. The following are the three definite charges formulated against the growing of this crop :—

(i) Jute is responsible for the famine and the high prices of food grains in Bengal.

(ii) Jute causes malarious fever in Bengal.

(iii) Jute makes the raiyats extravagant.

I shall try to prove that these charges do not stand on facts.

First Charge

It is true that since 1828, when the exportation of jute to Europe commenced, the cultivation of the crop has expanded in Bengal and Eastern Bengal and Assam with rapidity. But the total area under jute does not,

even now, exceed 6% of the total cultivated area in these two provinces. On the other hand, the area under rice is between 60 and 65%, and it does not appear to have been reduced, to any extent, within the last 20 years or so. The increase of jute area, without reducing the area under rice, may be accounted for by the fact that the area under cultivation has also considerably increased, specially in Northern Bengal. It will also be remembered that jute is immediately followed by transplanted paddy in the Northern Districts where jute is very extensively cultivated. Thus two crops are obtained from one and the same land, in the same season, without any appreciable harm to either. But assuming that jute has reduced the area under rice, we should not, even then, grumble, as it pays the raiyats better. Further, jute is an early crop harvested at a time when the raiyats are particularly in need of money. Again, in an emergency, jute may be cut at a comparatively early stage, bringing immediate relief, while in the case of the other crops, the raiyat is obliged to wait till they are ripe. There are also other reasons in favour of jute. The paddy crop, at times, fails in Eastern and Northern districts, owing to floods, which generally come in after the jute is off the ground. Thus a raiyat is sure to get, at least one crop, even in such a bad year. It is also known to all intelligent raiyats that no crop does well on the same land, year after year. Therefore, it is good to follow a system of rotation of paddy with jute where the soil is suitable for both of these crops. Owing to these and other reasons, the area under jute in Bengal was not.

very small even some 20 years back, when this crop was not considered nearly as paying as now.

The present abnormally high price of rice is chiefly due to two consecutive bad seasons in 1905-06 and 1906-07. The crop was seriously damaged by floods in Eastern Bengal and Assam in the former year and in Bihar in the latter, the net shortage, taking the two provinces together, amounting to 23 and 26 per cent. respectively in the two years. Exports, too, have been high of late, (*vide Appendices on the Area, Yield and Export of rice and wheat,*) though they fell off to some extent in 1906-07. It is not necessary for our present purpose to adjudicate as to what extent bad seasons, and in what measure foreign exports were responsible for the present high prices, but the fact remains, that, but for jute, the situation in Eastern Bengal would have been far more serious. On the other hand, the condition of the raiyats of North Bihar would not have been so bad, this year, if they had jute. From my long experience, as a Travelling Inspector of Agriculture in Bengal, I am decidedly of opinion, that the jute crop has, on the whole, improved the condition of the raiyats of the jute-growing districts in Bengal, who form the bulk of the population. It has been estimated that in 1906 jute brought in about 15½ crores of rupees to the cultivators as a clear profit.

* In the two provinces of Bengal and Eastern Bengal and Assam, the normal culture of cleaned rice may be estimated at about 52 crores of maunds.

Second, Charge

There are hardly any facts to prove that jute is responsible for the malarious fever in Bengal. If malaria had anything to do with jute, then, there is no explanation to offer for its prevalence in other parts of India which do not grow this crop. On the other hand, malaria is not severe, if at all present, in some parts of Mymensingh, Dacca, Faridpur, Tippera, Rangpur and Bogra, where jute is very extensively cultivated. Goalpara is the only district in Assam where jute is cultivated to any extent. This district is almost free from this disease.

Malaria prevails badly in localities where the drainage is imperfect, and where, in the vicinity of dwelling houses, dead rivers and stagnant ditches are found overhung by thick trees and shrubs obstructing the sun and free air. It is such villages that suffer most.

The modern theory of malaria is that it is contracted through the bites of a species of mosquitoes whose favourite breeding grounds are stagnant pools and marshes.

Of course, jute-steeping may cause drinking water to become foul, where reserved tanks or wells are not available. This filthy water may produce diarrhoea, indigestion or some other diseases rather than malaria. In fact the cultivators themselves never attribute any unhealthiness to jute-steeping. The stench is not certainly nice, but the discomfort to the nostrils is not without a very substantial ^{yet} off.

Third Charge

The third charge brought against jute is that the crop has turned the raiyats to become extravagant. This charge hardly deserves any serious notice. After the harvest of jute and the completion of their hard labour, if the raiyats spend a little money on some *hilsa* fish, milk, sweet-meats or a *mirjai* (a tight coat), none should grudge them such small comforts. On the other hand, we ought to rejoice at this. Even if there is any indulgence at present, we may hope, that, by and by they will of themselves learn economy. It will be a better training for them than the forced economy of poverty. We should be rather proud of our Hindu and Muhammadan raiyats who do not spend a single copper on drink, which brings about ruin on similar classes in other countries.

In conclusion, I may remind my readers that from an agricultural point of view, Nitrogen is the governing factor in the fertility of the soil. Any country, therefore, that exports nitrogenous compounds loses fertility, whilst a country that imports such compounds gains in fertility at the expense of the former. The export of food grains from India not only means the stiffening of present prices, but what is far more serious, it means increasingly diminished outturns in years to come. On the other hand, the export of fibres (such as cotton and jute,) oils (as distinguished from oil-seeds), sugar and starch—which are all non-nitrogenous products—from a country, does not, in any, way impoverish its soil. Add

to it the fact, that in our country we have no special deposits of nitrogenous manures, and unlike the farmers of other countries, the Indian raiyats would not buy such manures on account of their poverty and ignorance. From the point of view of agricultural economy, the export of jute fibre * cannot, therefore, be considered harmful.

CHAPTER II

THE HISTORY OF THE JUTE INDUSTRY

Regarding the history of the jute industry in Bengal, I cannot do better than quote extracts from Sir George Watt's "Dictionary of the Economic Products of India" which will be read with great interest.

"There can be no doubt that jute was known to the people of India from comparatively remote periods, but, as indicated under *C. capsularis* and *C. olitorius* from the confusion which existed down to the present century in the words *sunn*, *pat* or *patta*, *bhang* and *hemp* &c,

* The composition of jute may be represented by the empirical formula $C_{12}H_{18}O_9$ i. e., Carbon 47, Hydrogen 6 and Oxygen 47 parts in every 100 parts of the fibre. It contains no Nitrogen.

names applied to certain Indian fibres, it is difficult to determine for certain many of the fibre-yielding plants referred to by ancient writers. The probability is that *sunn-hemp* (the fibre of *Crotalaria juncea*) was better and earlier known to the ancient Hindus than jute, and that the true hemp (*Cannabis sativa*) was known to them, if not brought to India by their invading and conquering ancestors. It is almost safe to assume that in very remote times *sunny*, *patta* and *bhangi* were synonymous and generic terms for fibre and coarse cloth, without much regard to the plant from which the fibre was obtained. If so, about the beginning of the present century, the word *pat* became fixed and associated with the fibre of *Corchorus olitorius* and *C. capsularis*. Prior to that date Government returns of exports from India mention *hemp* fibre ; this must have been either *sunn* or jute, since the true *hemp* fibre has not been cultivated for centuries at least, and modern experiments have shown that the plant is not capable of cultivation as a source of fibre in the plains of India.

"With the advance of civilization, came an increased demand for cloth, at first as a luxury, and latterly as a necessity. Jute probably met this demand and, indeed the poorer people, little more than half a century ago, were largely clad in jute cloth of home manufacture, such as, at the present day, is used by the aboriginal tribes. The increased facilities for the importation of cheap European piece goods checked, however, the development of this indigenous industry ; but with the rapid progress in every other branch of enterprise, there

opened up a foreign trade in jute which the agriculturist found remunerative. The resources of the rich plains of India, Burma, and China, and latterly of America, Australia and Egypt were, by the British mercantile fleet, made available for the supply of grain. Bags were required for this trade, and thousands of rough gunnies were greedily bought up. The high price obtained was a powerful incentive to increased activity, and thus the gunny bag trade rapidly became a recognised part of the Bengal peasant's work. By and by, however, European machinery began to compete with manual labour, and in due time it gained the day. Jute was exported to Europe for cordage, and ultimately for the manufacture of the bags required in the grain trade. The first commercial mention of the word 'jute' is in the customs returns of the exports for 1828, when 364 cwt. were sent to Europe. Soon the agriculturist found that his time would be more profitably spent in preparing an extra quantity of fibre, than in manufacturing bags to compete with steam and mechanical appliances ; the preparation of fibre speedily outstripped the demand for home manufacture, and a large export trade was established in raw jute to feed the Scotch mills. Thus transferred from its original home, the gunny trade took a new start in Dundee, and down to the year 1854 little or no effort was made to improve the Indian manufacture by the application of European machinery. In that year, however, the 'Ishera Yarn Mills Company' was established at Ishera near Serampur by Mr George Ackland, a large owner of coffee plantations in Ceylon, and a non-official

member of the Legislative Council of that Island ; these mills were afterwards called the 'Ishera Company, Limited', and are now known as the 'Wellington Mills.' Three years later (1857) the 'Borneo Company, Limited', a company originally established to exploit the Island of Borneo, founded the mills now known as the 'Barnagore Jute Mills.' In 1863-64 the 'Gouripur Jute Factory' came into existence. Following these, factories sprang up rapidly in every direction around Calcutta. In the Trade Returns for 1869-70 the exportation of manufactured jute was 6,441,863 gunny bags manufactured by power and handlooms, and brought into competition with the Dundee bags. This trade developed steadily, and in 1879-80, ten years later, over 55,908,000 gunnies were exported from India.

"But speaking purely of India's foreign trade in jute and jute manufactures it would seem that even with 24 large European factories at work in India, and the handlooms which still survive, scattered over the country, her raw jute interests are four times as valuable to India as her manufactures. A comparison between the exports of Indian 'power loom' as compared with 'hand loom' manufactures will still further show the extent to which the jute manufactures have passed out of the hands of the Indian peasants, who alone, little more than 40 years ago, met the demand for gunny bags. At that time (1850-51) the value of the gunnies exported was greater than that of the raw jute—the former being £ 215,973, the latter, £ 197,071. There were no European factories

in India in 1850, so that the market was supplied by the Indian peasant's hand loom".

There are now 43 mills at work in Bengal and one in Bombay. The number of looms working in 1887 was 7,164, which increased to 9,841 in 1895, and to 23,884 in 1905 and to 26,799 in 1906. These figures show a great development of the jute industry in Bengal. The actual consumption of jute by these mills has doubled during the last 10 years; while the foreign exports of raw jute have continued to increase very steadily, each year exceeding the preceding one.

CHAPTER III

RACES OF JUTE

There are two cultivated species of jute, e. g. *Corchorus capsularis* and *Corchorus olitorius*. *C. capsularis* is easily distinguished by its rounded capsules, while *C. olitorius* bears long cylindrical pods. The races of *C. capsularis* are more numerous than those of *C. olitorius*.

Jute is commonly called *pat* in Western and Central Bengal, *pat* or *koshta* in Eastern Bengal, and *pata* in the northern districts of the two provinces of Bengal and Eastern Bengal and Assam. In Orissa it is called

nalita or *jhout* and in Bihar *patua*. The local names of the different races of each species vary in different localities. There is no common vernacular name for either of the two species. For convenience' sake *C. capsularis* may be called *Guti pat* from the rounded shape of the fruit of this species, and *C. olitorius* may be called *Shuti pat* from the pod-like shape of its fruit.

C. olitorius is principally cultivated in the districts of Hoogly and 24-Parganas. The Northern jute is exclusively *C. capsularis*. In Eastern Bengal, *C. olitorius* is cultivated to a very limited extent.

The fibre of *C. olitorius* separates more readily from its stalk than that of *C. capsularis*, hence this species is preferred, in some quarters, specially in West Bengal.

C. capsularis when it is about 5 feet high, can withstand water submersion up to its middle. *C. olitorius* cannot stand water-logging at all, until it is ready for cutting. On the whole, *C. capsularis* is better capable of withstanding adverse climatic conditions, such as, drought or excessive rains or high temperature.

In colour and fineness, the fibre of *C. capsularis* is much superior to that of *C. olitorius*, but it is commonly somewhat inferior in length. The colour of the fibre of *C. olitorius* is silky yellowish which is very much liked by the sack-weavers in Eastern Bengal. From this peculiar colour, the fibre of this species can easily be distinguished from that of *C. capsularis*, although the colour of the fibre depends

chiefly on the cleanliness of the water in which it is steeped and washed.

The fibre of *C. olitorius* is more brittle. Roxburgh found, in his comparative tests of the fibres of India, that a "dry line" of *C. capsularis* broke with a weight of 164 lbs, and a "wet line" with the same weight; whereas *C. olitorius* gave way with 113 and 125 lbs respectively, the wet line gaining 12 lbs in weight. This fact of the superiority of the fibre of *C. capsularis* over that of *C. olitorius* is well known. Under the same test a "dry" and a "wet" line of *san hemp* broke with 160 lbs and 209 lbs respectively. The best fibre of *C. capsularis* is sold at a higher price than the best fibre of *C. olitorius*.

The colour of living plants of *C. capsularis* varies from light green to purple, while that of *C. olitorius* from light green to pink. It does not appear that purple or pink colour of the stems of the plants has any thing to do, in particular, with the colour of the fibre. Generally speaking, green-stemmed races of *C. capsularis* are more liked by the jute cultivators excepting those living in the districts of Purnea and Dinajpur, who prefer purple stemmed races which are said to be more prolific than the paler races.

The same race of jute would yield fibres of different qualities if grown in different places, under different conditions. The low land jute is always inferior to the high land jute. The low land jute which is grown in water is always "mossy" at the bottom and harsh. This portion of the fibre is cut off, before it is spun, and is kept apart

as a paper material. The best sorts of jute available at the Serajgunj and the Naraingunj markets are the products of high lands. The *Dowrah* jute of Madaripur which is sold at the lowest price was almost equal to the best Mymensingh jute, when grown side by side, at the Burdwan Experimental Farm during 1904. The following table shows the experts' valuation report on the samples of jute submitted to the Calcutta Baled Jute Association for appraisal :—

Commercial name of the jute.	Local name of the race.	Value per maund. RS.—AS.
Dowrah	{ (1) Sut pat (2) Udhappat	7—2 8—2
Naraingunj	Dhalsundar	7—12
Serajgunj	Baran	8—2
Northern or Uttarya	{ (1) Ausa (early) (2) Hewti (late)	8—5 8—6

According to the colour of the stems, leaf-stalks and fruits, the races of jute may principally be divided as follows :—

(A) *Cotchorus capsularis* ,

(1) Light green :—Kakya Bombai and Barapat of Serajgunj, Baron or Barapat of Mymensingh, Dhaleswar of Dacca, Hewti (white) of North Bengal.

(2) Light green when young, afterwards purplish :—Amonea of Faridpur, Deswal of Serajgunj.

(3) Purple :—Meghnal or Nalpat of Faridpur, Agni-swar of Dacca.

(B) *Cocchorus olitorius*

(1) Light green :—Bangi or Dewnallya of Dacca, Satnala, Bangi or Bomi or Bagi of Faridpur.
 (2) Pinkish :—Nileta or Tallah of Mymensingh, Tossa of Serajgunj.
 (3) Pink :—Desi Lalpat of Hoogly, Tossa (2) of Serajgunj, Nal Bagi of Faridpur.

Both the species have early and late races. The late races yield generally a heavier outturn than the early ones. Both of these races are however useful. The low lands, subject to floods, should always be cultivated with the early sorts of jute. Those who wish to cultivate jute on a large scale should sow both early and late races, so that the different races may be harvested at different times. It would not be possible to harvest the crop of all the fields at the same time. Under favourable conditions, jute is a very quick growing plant. It is particularly important that the soil should be rich, and that during the early stages of its growth, the crop should receive proper treatment. Otherwise, the plants get stunned, flower early and give a poor outturn. The following are the selected races of jute showing whether they are early or late.

Early

C. capsularis :—

Ausa of Mymensingh (mixed colour)

Bhadya of Rangpur and Jalpaiguri (Do)

C. olitorius :—

Bangi of Dacca (green)

Satnala of Faridpur	(green)
Tosha of Sarajgunj	(mixed)

Late

C. capsularis :—

Baroa or Barapat of Mymensingh	(green)
Kakya Bombai of Serajgunj	(green)
Deswal of Serajgunj	(mixed)
Amonea of Faridpur	(green)
Kamarjani of Faridpur	(green)
Hewti of Rangpur	(mixed)
Nalpat of Faridpur	(purple)
Kajla of Dacca	(purple)

C. olitorius :—

Desi Lalpat of Hoogly	(pink)
Dewnallya of Dacca	(green)
Halbelati of Tipperah	(green)
Nailta of Mymensingh	(green)

Comparative statements of the outturns of the races of jute grown experimentally at the Burdwan Farm during the last 4 years, are given below. From these it will appear that there is no particular variety or race which is the heaviest yielder. Dewnallya of Dacca topped the list in 1903, but it was placed much lower down the list, in the following year. So again, the race which gave the highest outturn in the second year came down in the next year. The Burdwan Farm seed, which was originally the same as the Deswal of Serajgunj, has occupied the first place during the last two successive years. From two years' results we cannot pronounce any definite opinion, as, it may give a different result.

in the next years. This is undoubtedly one of the best races we have. I particularly mentioned it in my report on the Jute Experiments at the Burdwan Farm during 1902, the first experiment carried out at Burdwan, at the instance of the Inspector General of Agriculture in India. The Burdwan Farm seed seems to have improved by careful selection. At Serajgunj Kakyà Bombai is considered the best of all, specially when both outturn and quality are taken into account. The seed of Kakyà Bombai race is generally indented by the cultivators from Goalpara district in Assam. It is said that the seed of this *jar* of jute produced at Serajgunj is not such a good yielder as that obtained from elsewhere. Interchange of seeds is therefore highly recommended by the experienced cultivators of Serajgunj.

VARIETY EXPERIMENTS WITH JUTE

1903

At Burdwan

Name of jute.	Outturn per acre.
(1) Dewnallya (<i>C. olitorius</i>) of Dacca	2661 lbs.
(2) Kajla (<i>C. capsularis</i>) " " "	2581 "

1904

At Burdwan.

(1) Hewti, white, (<i>C. capsularis</i>) of Rangpur	2310	"
(2) Kakyà Bombai (<i>C. capsularis</i>) of Serajgunj	1935	"

At Faridpur.

(1) Barapat (<i>C. capsularis</i>) of Mymensingh	2936	"
(2) Amonea (<i>C. capsularis</i>) " Faridpur	2991	"

At Rangpur

(1)	Kamarjani (<i>C. capsularis</i>) of Faridpur	2,644
(2)	Hewti, white, (<i>C. capsularis</i>) local	2,310
	At Jaldhikur (A)	
(1)	Baron (<i>C. capsularis</i>) of Mymensingh	1,110
(2)	Nalpat (<i>C. capsularis</i>) of Faridpur	1,049

1905

At Burdwan

(1)	Farm-seed (<i>C. capsularis</i>)	2,600
(2)	Nailta (<i>C. olitorius</i>) of Mymensingh	2,400

1906

At Burdwan

(1)	Farm seed	2,600
(2)	Halbilati (<i>C. olitorius</i>) of Tippera	2,480

* The jute fields were not weeded in proper time.

PART II—CULTIVATION

CHAPTER IV

SOILS

In Bengal there are old and new alluvial soils which are called *lal mati* or *khair* and *pali mati* respectively, the same as *bhangar* and *khadar* in Bihar. The new alluvium is generally found near large rivers especially in their deltas, and is commonly called alluvial soil *par excellence*. The soils of parts of Orissa, South Bihar and Burdwan Division, belong to old alluvium. The whole of North Bihar, Eastern Bengal and North Bengal consists of new alluvium, with the exception of the Madhupur Jungle in Dacca and Mymensingh and the *khair* in North Bengal. Jute grows on new alluvium but not on the old. A striking example of this fact may be cited :—In Bogra there is a narrow river called *Karotoya*. Over 50 per cent. of the cultivated *pali* lands lying to the east of this river is, every year, sown with jute, while, the cultivated *khair* lands, to the west of the *Karotoya*, contain jute not exceeding 5 per cent. None should select this *lal* or *khair* soil for jute, unless the character of this soil is thoroughly changed by heavy application of cattle manure or by green manuring for three or four years successively. *Khair* land becomes very hard in a drought, and prevents the spread of the roots of the

jute plant. This seems to be the chief reason why it is so unsuitable for this crop.

Jute is very badly affected by water-logging when it is young. The rain water sinks quickly into loamy soil; hence loamy soil is preferred to stiff clay which can neither absorb nor part with its water as readily as loam or sandy loam does.

It is said that jute will grow in the *salt-impregnated soils* of the Sundarbans. I am however not prepared yet to accept this view as true. Of course, in some tracts of the Sundarbans, jute has been successfully cultivated. Perhaps most parts of the salts contained in the lands had been removed by drainage, before jute was grown. It would be best to proceed cautiously and see whether jute will grow on soils from which the salts have not been so thoroughly removed. It is very well known that when a soil contains soluble salts above a certain amount, it is unfit for any crops. Even saltpetre, if present in the soil water in a too concentrated form, acts as poison for plants. Dr. Voelcker's experiments show that no crops grow on soils (surface soil) which contain 2 per cent. of soda, 4 per cent. of common salt, or 17 per cent. of sodium-sulphate.

Jute grows on the high lands, as well as, on the low lands which are not liable to submersion before the middle of June. Floods cannot do much harm to the plants once they are sufficiently strong, that is, when they will shortly run to flower. Of course, highland jute is always superior to lowland jute in quality.

CHAPTER V**CLIMATE**

Jute is a rainy-season crop. Damp heat is the most favourite condition for its growth. Excessive rain saturating the soil with moisture, prevents both sowing of the seed, and the weeding and thinning of the young plants.

From one to three inches of rain distributed in a month, during sowing period, may be considered sufficient. Occasional showers of rain varying from one to two inches, at intervals of about a week, are most beneficial for the growth of the plants.

The temperature of atmosphere on the tracts where jute is grown does not exceed, during the growing season, 100° F. nor fall below 60° F. It is not possible to grow jute anywhere in Bengal during the cold weather.

CHAPTER VI**THE EXTENT OF CULTIVATION**

The cultivation of jute has been rapidly extending owing to the high prices of this fibre during recent years. The price still continues high. The demand for the fibre is increasing steadily. New markets

are continually being opened out. There can be little doubt that the cultivation of jute will, in the near future, extend largely in Bengal and Assam. At present, jute is extensively cultivated in the districts of Mymensingh, Rangpur, Tippera and Purnea. In Mymensingh nearly one third of the total cultivated land (801,000 acres) is under jute which yields about one fourth of the whole production of jute of these provinces. The other three districts account for about 29 per cent. (933,900 acres) of total area under jute in Bengal and Eastern Bengal and Assam. Thus more than half (54%) of the total outturn of jute is obtained from these four districts. The total area under jute at the present time (1906) is nearly 10 per cent. of the total cultivated land of the districts in which jute is grown. Taking the whole cultivated area of the two provinces of Bengal and Eastern Bengal and Assam into consideration, the percentage of area under jute was 5.5 in 1906. The total cultivated area in these two provinces is 59,705,100 acres, of which 3,337,500 acres were cultivated with jute during 1906.

The experimental cultivation of jute in several indigo estates in North Bihar has been successful. It is expected that it will shortly take its place among the regular crops in that tract. In Assam proper there is very little jute at present. Goalpara is the only district where jute is cultivated to some extent (28,000 acres in 1906.) The cultivation of jute may extend in the near future in the Assam Valley where the soil is alluvial.

CHAPTER VII

ROTATION

In some quarters jute is grown on the same land year after year. This is an exhaustive system. This system should never be resorted to unless sufficient manures are used. Of course, the lands which are submerged during the rains and thus receive silts, do not generally require any manuring.

In the principal jute districts where jute is cultivated on high lands, paddy is transplanted immediately after cutting jute. Thus two crops are obtained in the same season. This is undoubtedly a most exhaustive method, if this land is not heavily manured. It may be noted that jute does particularly well if it follows peas or *khesari* grown specially for grazing.

The following rotation schemes are recommended :—

Two Year Scheme No. I

First Year

- (i) Jute ;
- (ii) Rape or mustard.

Second Year

- (i) Paddy ;
- (ii) Peas or *khesari*.

One Year Scheme No. 2

(If jute is immediately followed by paddy)

First Year

- (i) Jute ;
- (ii) Paddy ;
- (iii) Peas or *khesari* (grown for feeding cattle).

Second Year

- (i) *Aus* paddy ;
- (ii) Potatoes, or rape, or mustard, or *sun hemp* as a green manure if no other manure is used for the next jute crop.

One Year Scheme No. 1

- (i) Jute ;
- (ii) Rape or mustard or peas or *khesari* or potatoes.

One Year Scheme No. 2

(If jute is immediately followed by paddy)

- (i) Jute ;
- (ii) Paddy ;
- (iii) Peas or *khesari* (grown for feeding cattle).

One reason why *rabi* crops are not generally allowed to precede jute, is perhaps that in the Eastern districts, jute has to be sown early to prevent its being swamped by the flood. Here the *rabi* crops interfere with the preparation of the soil sufficiently early. But mustard is soon off the ground. Peas &c. for fodder also do not interfere with the early preparation of the soil.

CHAPTER VIII

PREPARATION OF THE SOIL

Land for sowing jute is generally prepared just after the first shower of rain during the latter part of February or March. Intelligent cultivators should never lose the opportunity of early rain. If there be no cold weather crop in the field, the ploughing should begin early in the cold season. Deep ploughing is essential for this crop. It has long roots which go down about one foot below the surface of the soil. Soil should be thoroughly pulverised until a fine tilth is obtained. Clods in the clay soil are to be broken by means of a *harrow* or *kodali* or a wooden mallet. No treatment should be given to the land when it is too moist. Five to eight ploughings and four or five ladderings will be often found sufficient. Clay soil may require as much as ten ploughings. The corners of the fields which are not properly broken by ploughs should be grubbed by *kodali* before the last ploughing is given. The harrow and grubber would be useful implements for crushing clods and collecting weeds. These implements are little known in these provinces where jute is grown. After sowing, there should be no ploughing, unless the soil is very light, but simply ladderding to cover the seeds, and to press the land in order to bring up the moisture to the surface of the soil which helps germination of the seed.

CHAPTER IX

MANURES AND MANURING

Jute does not appear to be an exhaustive crop. Theoretically speaking, the crop itself, that is the fibre, removes no valuable plant foods, such as, nitrogen, phosphoric acid and potash. But there has been no analysis of the entire jute plant and nothing is definitely known yet as to how much nitrogen or phosphoric acid is removed from the soil by an average crop. It is however presumed that the soil would not lose much if the leaves, unnecessary tops and piths of the jute plants be returned to the fields.

Low lands which receive silts every year from floods require hardly any artificial manures. Jute does particularly well if it follows peas or khesari grown specially for feeding cattle on the field. Pulses have special capacity for enriching the soil.

Green manuring with *sans* is strongly recommended for jute. It is to be sown in November or December and ploughed early in February. Green manure is specially useful when the character of the soil is required to be changed. By green manuring stiff clay becomes lighter and the light sandy soil becomes retentive of moisture.

The manure experiments with jute at the Burdwan Experimental Farm have shown that cowdung is the best of all manures for jute. Cowdung is followed by

castor-oil-cake. Seventy-five maunds of cowdung or 6 maunds of castor cake per acre, each containing about 30 lbs * of nitrogen, may be applied, when the land is finally prepared. The following statements of the results of the manure experiments at the Burdwan Farm may be read with interest.

Old Experiment

MANURE	QUANTITY OF MANURE PER ACRE	OUTTURN OF FIBRE PER ACRE AVERAGE OF 11 YEARS
Cowdung	150 maunds	1,821 lbs.
Castor cake	6 maunds	1,448 ,,
Super-phosphate	1 md. 20 seers	1,358 ,,
Saltpetre	30 "	
Bone meal	3 maunds	1,252 ,,
No manure	...	648 § ,,

* Mr. Mollison the Inspector-General of Agriculture in India has recommended 30 lbs. of nitrogen per acre for the Burdwan Experimental Farm.

§ An exceptionally poor crop. The lowest outturn from the unmanured field of the New Experiments is 1,230 lbs. of fibre per acre. The unmanured plot of the Old Experiments was perhaps unsuitable for the crop.

New Experiments

MANURE	QUANTITY OF NITROGEN PER ACRE *	OUTTURN PER ACRE IN lbs.		
		1904	1905	1906
Cowdung	30 lbs.	1,985	1,805	1,880
Castor cake	30 „	1,635	1,570	1,860
Bone-meal and	15 „	1,605	1,590	1,600
Saltpetre	15 „			
Bone-meal	30 „	1,085	1,580	1,560
No manure	...	1,230	1,545	1,560

All the above manures excepting super and saltpetre should be applied to the fields during the preparation of the soil. Super may be used with sowing of the seed, and saltpetre as a top-dressing, when the plants are about one foot high. The latter should always be put on the land on which there is a growing crop, as it is readily soluble in water and liable to be washed off.

* Cowdung contains on the average 5%, castor cake 5% bonemeal 3% and saltpetre 10% of nitrogen.

CHAPTER X**SOWING**

Sowing season extends from about the middle of February to the end of May. On the low lands which are liable to be swamped by floods, sowing is finished by the middle of March. When the land is thoroughly prepared, seed is broadcasted and covered by laddering. The seed is sown at the rate of 10 lbs. of *C. capsularis* or 8 lbs. of *C. olitorius* per acre. To ensure an even distribution of the seed, sowing should be carried out cross-wise, that is, the field should be gone over by the sower, in the act of sowing, once from north to south, and a second time, from east to west. A harrow or a ladder or a *henga* (log) should follow immediately to cover the seed properly. Germination takes place within three or four days after sowing, if the soil contains sufficient moisture.

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CHAPTER XI**AFTER TREATMENT**

When the plants are about six inches high, a *bida* (some thing like a rake) called *achra* or *nangla* in North Bengal is drawn over the land twice or thrice at short

intervals, till the plants attain a height of nearly one foot, for thinning the plants and loosening the earth. After this, the crop is twice weeded or hand-hoed, the operation being accompanied by thinning at the same time. The outturn of fibre depends much on this operation of weeding and thinning. Jute fields should be well cleaned of weeds. Sometimes three weedings or hoeings are given. The plants should be so thinned as to leave a space of about 6 inches between the plants, in the case of *C. capsularis*, and 8 inches in the case of *C. olitorius*. *C. capsularis* will bring forth numerous branches if the plants are thinned out over-much. On the other hand, thickly crowded plants will grow too thin to give a good outturn of fibre. Just before the rainy season sets in, the thin and weak plants are finally up-rooted. These plants * should be thrown into the manure-pit. No operation should be given when the fields are too wet, that is, when the earth sticks to the implements. It is very essential that every operation is given just in proper time. It will harm the crop very much, if any operation is delayed even for a few days only. Every treatment of the plants should receive the cultivator's utmost care. Well treated plants will often grow 10 to 12 feet high.

* Now a days fibre is generally extracted from these rejected plants and sold as "bach pat" (rejected jute.)

CHAPTER XII

CUTTING

Jute is cut from the beginning of July to the end of October. It is hardly ever cut before the flowering stage of the plants. It may be cut any time before it is dead ripe. The time of cutting may be divided into three stages, as follows ;—

First stage—cutting in flower ;

Second stage—cutting when fruits set ;

Third stage—cutting when fruits fully develop.

Four weeks are taken by the plants to pass through these stages. Sometimes the cutting is delayed by a raiyat for want of sufficient labour. But, if the plants are allowed to get dead ripe, the fibre becomes coarse in texture and dirty reddish in colour. The heaviest yield of fibre of good quality is obtained when the plants are cut at the third stage. Those who would wish to undertake the cultivation of jute on a large scale, must begin cutting from the first stage, so that, they may be able to skilfully distribute the work of harvesting over a long period. It would not be possible for them, for want of labour and other difficulties, to cut the whole crop at the stage which may be the fittest of all.

Plants are cut with a sickle close to the ground. Plants growing in deep water are pulled up. After cutting or pulling, the plants are tied in bundles and steeped in water.

CHAPTER XIII

STEEPING

Jute fibre is contained in the bark of the plant. In the natural state, the fibre is associated with a kind of gum which must be first softened by fermentation and then removed by washing. The fermentation takes place when the plants are cut and kept under water. This is called *steeping* or *retting*.

When the crop is grown on high land above inundation, the bundles are stacked on the field for two days, before they are removed to a ditch for steeping. This is a good practice as the leaves of the plants may be shed and thus kept on the soil which has produced them. It also reduces the weight of the bundles which are to be carried away a long or short distance. Calculating on the basis that the fibre is 4.5 per cent. of the green weight, 16 maunds of fibre per acre means a crop with a green-weight of 355 maunds or 29,000 lbs. The bundles of a stack should be covered with straw or palmyra leaves. If the plants are directly exposed to the sun, the fibre becomes more or less 'specky'. The bundles are then removed to the nearest pool and immersed. In Western Bengal where deep water is not generally available for steeping, from one to two layers of bundles are bound together with rejected plants and placed in water. Sods of earth are used there for weighting down the stack. This practice is condemned as it tends to discolour the

fibre. This may partly explain why the *daisee* jute is much inferior in colour to Eastern Bengal jute. Logs of woods may always be preferred.

In Eastern Bengal, where jute is cut in water, the steeping begins at once with the leaves on. Several layers of bundles are placed one over another. The second layer covers the first layer completely leaving only the top 9 inches, and so on. Finally the last layer is covered with weeds. After 5 or 6 days the leaves of the plants wither off. At this time the whole heap is completely covered with weeds. This system hardly requires any artificial weight—the bundles immerse by their own weight. Sometimes cultivators erect bamboo posts on either side of the heap to keep it from floating away.

The plants take 10 to 20 days to ret. When the plants are cut in the latter period of the season, it may take even a month for retting—the period depending upon the maturity of the plants, the temperature and other conditions of the water in which the plants are steeped. After a week or so the plants should be examined to ascertain how far the retting has advanced. The examination should be repeated from time to time, till it is found that the fibre separates easily from the stalk. If underretted the gum remains more or less and the fibres stick together. On the other hand, over retting makes the fibre weak and dull.

The water in which jute is steeped has considerable effect on the quality of the fibre. The fibre of jute steeped in clear water called *kala jal* (black

water) gives it a white colour, while the colour of the jute steeped in muddy water called *baga jal* (*baga* = white, truly speaking grey, *jal* = water) is blackish grey. The stagnant *baga* water gives the jute a better colour, because it is not as muddy as the running *baga* water. In the case of "black water" whether running or stagnant the colour of the fibre is not affected, as this water does not contain any dirty matters. The steeping of jute in running water takes longer than in stagnant water. In running water, the inside bundles of a heap rot earlier than the outside bundles producing fibre of uneven quality. Thus when the retting of the bundles within is complete the outside bundles are not yet ready. On the other hand, when the outside bundles are fit for stripping, the inside bundles will be overdone. It is required, therefore, to break the stack and take away the inside bundles when they are ready for stripping, leaving the outside bundles in the steep for 2 or 3 days longer. Stagnant water is to be preferred to running water. Deep water is also to be preferred to shallow water in which the lowermost bundles touch the ground to the detriment of the colour of the fibre.

The crop is so bulky when it is cut that it is not always possible to carry it a long way off, to get clean water for steeping.

CHAPTER XIV

STRIPPING AND WASHING

Separating the fibre from the stem must be finished within a couple of days after retting process is complete. The principal methods of extracting fibre from the stem are as follows :

First method.—Each plant is separately stripped so that the fibre remains free and without any entanglement, commanding a higher price. The stripper generally a woman, does the work in her own home, instead of standing in the steeping water as in the other processes. She holds the lower part of the stem of each plant with her right hand and dexterously pulls the fibre off with her left hand—the fibre passing between the fore and middle fingers of the right hand in which the stem is held. A skilled woman can extract even three plants, at a time, passing three bunches of fibre of three different plants, through the three spaces made with the four fingers of her right hand which hold the stems. A woman ordinarily strips about half a maund of dry fibre, working 8 hours a day. But there are skilled women in East Bengal who can strip more than that quantity. The woman is either a member of the raiyat's own family, or one of the family of a friend of his, who charges nothing for the work ; but she gets the stalks or piths only which are used as fuel.

Dacca, Faridpur and Barisal are the only three

districts where jute is separated in this method.

Second method.—When the stems are ready for stripping, the raiyat stands by the heap and takes up a handful of the plants, which are beaten at the bottom by means of a wooden hand and afterwards broken at the distance of one foot from the bottom. The broken pieces of wood are then thrown away. He now takes hold of the separated fibre by both the hands, and jerks the stems forward and backward, on the surface of the water. After half a dozen jerks, the fibre is cleared off the stalks. A cultivator generally strips 20 seers of dry fibre per diem working from 8 a. m. to 2 p. m. But, if he is not accustomed to this work, he would not be able to extract more than half that quantity.

This method is in vogue in almost all the jute districts in Bengal.

Third method.—When ready, a handful of stems is taken hold of by both the hands of the stripper, and dashed against the water swinging round the head. This is a process which may correctly be called washing rather than stripping. After the stems are washed in this way, they are dried in the sun. At last the piths or stalks are broken at several places and removed from the fibre. Jute is stripped in this method in Orissa.

The first process of stripping jute fibre may further be improved by substituting a bamboo or wooden frame for the hand, with more pegs for fingers than a woman commands in one of her hands. This frame may be constructed in the following way :—

Take a piece of bamboo or wood 18 to 20 inches long. Attach some 8 or 10 finger-like thick round wooden or bamboo pegs 8 or 9 inches long to the wood or bamboo frame, at intervals of about $1\frac{1}{2}$ inches from one another. This frame, with its pegs up, may be tied to two posts, about 3 feet above the ground, so that, a man can work standing.

Now, first, the fibre at the bottom of a plant is to be loosened and put on the frame for work. Each peg should go between the separated portion of the fibre and the pith of a plant ; thus when all the pegs are ready, the worker should take hold of the fibre by both the hands and drag it out. It would be more advantageous if two men be employed to work together with one frame. It would undoubtedly be found a simpler process than any. Two men would be able to strip about two maunds of dry fibre in a day.

The separated fibre should always be washed in clean water. It would be much better, if running water is available for washing, as in that case, the separated dirt is removed by the current, without affecting the next bundle of fibre.

The washing is generally done by taking a handful of fibre which is pulled right and left in the water and sometimes dashed against it. After washing the fibre is dried in the sun over a bamboo frame for two or three days and then tied into bundles for market.

The best sort of jute is obtained, when it is steeped in deep, clean and stagnant water, properly retted, and

washed in clean running water, provided the plants are well grown on high lands not liable to be submerged by floods before cutting.

CHAPTER XV

OUTTURN OF FIBRE

The official estimate of the average normal outturn of jute per acre is 15 maunds. On well cultivated and manured land an outturn of even 30 maunds per acre may be expected—24 maunds per acre are commonly obtained.

CHAPTER XVI

COST OF CULTIVATION AND PROFIT

The cost of cultivation and preparation of the fibre of jute varies with the conditions of the localities in which it is grown. In North Bihar and Orissa, labour is available at the rate not exceeding 3 annas per diem, while in Bengal the rate of the labour, during the jute season, varies from 4 to 6 annas per diem. The following table will show, in detail, the necessary costs required for cultivating an acre of land, in an East Bengal district, where labour is dear. Extra cost would be necessary

if the fibre is to be tied in drums intended for despatch to Calcutta.

8 ploughings (1 ploughing requires 3 ploughs)	12 0 0
5 seers (10 lbs.) of seed @ 4 annas a seer	1 4 0
2 rakings with bida	1 8 0
First weeding—24 men—at 5 annas per head	7 8 —
Second weeding—12 men	3 12 —
1 thinning—6 men	1 14 —
Cutting and steeping—24 men	7 8 —
Stripping at the rate of Re. 1 per maund (16 maunds)	16 — —
Collecting fibre and tying—2 men	— 10 —
Rent	6 — —
	<hr/>
Total Rs.	58—0—0

Additional costs for manuring :—

(i) 100 maunds of cowdung @ 8 annas per cart-load	5 — —
Application of manure requiring 4 men	1 4 —
	<hr/>
	6—4—0.

(ii) When required quantity of cowdung is not available :—

Cowdung 50 maunds	2—8—0
Application of manure	—10—0
Castor cake 3 maunds	6—0—0
Crushing castor-cake	—12—0
	<hr/>
Rs.	9—14—0

(iii) When cowdung is not available
6 maunds of castor-oil cake

• @ Rs. 2 per maund	12 — —
Cost for crushing castor-cake	1 8 —
	Rs. 13—8—0

The cost of cultivation in Eastern Bengal, would ordinarily amount to about rupees 56, that is, at the rate of about Rs. 3—8 per maund. An additional expenditure of between *Rs.* 6 and *Rs.* 14 is required, if the land is manured. If the yield be taken at 16 maunds per acre, when the land is not manured, the value of the outturn may be estimated at *Rs.* 120 at the rate of *Rs.* 8 per maund, leaving a net profit of about *Rs.* 72 per acre, or *Rs.* 24 per Bengal bigha. As jute responds readily to manuring, it is always advisable to incur a small extra expenditure for this purpose. It may be expected that manuring would increase the outturn at least by 6 maunds per acre, adding *Rs.* 48 to the gross value, at the cost of, say, *Rs.* 10 in the case of cowdung being supplemented by castor cake, when the required quantity of the former is not available.

CHAPTER XVII

INJURIES

Continued drought is detrimental to the jute crop. The greatest enemy of the crop is heavy rain which

may fall just after the seed has been sown or when the plants are still young. Stagnant water during this period is still worse. Floods would not harm some races of jute grown in Eastern Bengal when the plants come into flower-bud.

There are several insect pests which cause considerable damage to the plants when they are young. The worst are two or three kinds of caterpillars called *chhitapoka* (leaping insects) in Faridpur. These appear generally in very dry seasons. Continued rains, on the other hand, are favourable to hairy insects called *shuapoka*. Plants affected by these insects become branchy and the fibre obtained from them is specky and harsh. Kerosine emulsion * which may be applied with Eclair vaporiser or any fine syringe is a sure remedy against all these insects. During 1904 the experimental jute crop on about 5 acres of land at Faridpur was very badly attacked by the *chhitapoka*. I was deputed by Mr. Maddox to try some remedies there. Kerosine emulsion was applied by me which saved the crop, while the neighbouring fields suffered a loss of about 50 per cent. The outturn of the experimental fields has already been given in page 16.

* For detailed instruction for preparing kerosine emulsion please see Part V.

CHAPTER XVIII

PRESERVATION OF SEED

Very little attention is paid by the raiyats to the selection and preservation of jute seed. A raiyat ordinarily preserves neglected plants on the border of a field for the purpose of obtaining seed from them. This is a pity. Vigorous individual plants which are not branchy should be set aside for the purpose.

An acre of land may yield as much as 6 maunds of seed. After harvesting, seed should be preserved in an earthen jar (*jala*) mixed with some ashes, and carefully covered with an earthen stopper, preventing the access of insects to the seed. The *jala* should be painted inside with coaltar and dried beforehand. Before sowing, 100 seeds from a lot should be tested between two pieces of wet blotting paper. Good seeds will germinate in a couple of days. The seed may be considered good, if 80 of the seeds germinate. Considering the present value of jute, it would be suicidal to neglect the quality of the seed. The cultivators of East Bengal where land is inundated should always indent good seed from elsewhere. On the other hand, the quality of the fibre may deteriorate if the same seed is sown on the same land for a number of years. Interchange of seeds is therefore recommended.

PART III—TRADE

CHAPTER XIX

INDIAN MANUFACTURES

The manufacture of jute fabrics by hand is an old industry of Bengal. Jute cloth was used for clothing by the poorer classes some 80 years ago, when its use for this purpose was checked by the importation of cheap and good-looking European cotton goods.

The principal articles of hand-loom manufactures of India were gunny bags, mattings, rugs, and sails for country boats. Paper was also manufactured out of jute in several districts in North and East Bengal. The Indian weavers used to dye the fabrics in red, black and yellow colours of their own.

Prior to 1857 the exports of jute manufactures from India represented hand-loom fabrics. In 1850 these manufactures were valued at Rs. 21,59,780 (£215,978). Since 1854, the hand-loom industry of jute has rapidly declined. During 1880—81 the value of the total exports of manufactured jute amounted to Rs. 1,13,06,716 of which hand looms accounted for Rs. 2,69,553 ; in 1887—88 the hand loom manufactured articles exported were valued at Rs. 89,220 only, out of the total exports to the value of Rs. 1,15,18,577.

The old hand loom industry of jute in India is now

well-nigh defunct. The only industry still left in the hands of the people of this country is the manufacture of ropes wanted in their houses for every day use. A Bengali family consumes at least half a maund of jute a year for domestic purposes. Gunny bags are still woven in some districts to a limited extent.

In the European factories set up in India, jute is chiefly manufactured into hessian cloth and gunnies. "Rejections" and "cuttings" of jute are used by a few paper mills. Coarse and strong qualities of the fibre are used in some steam rope works for preparing cordage.

CHAPTER XX

EUROPEAN MANUFACTURES

In European countries and America jute is manufactured into shirtings, curtains, carpets, and rugs. The great bulk of this fibre, however, is made into such commoner classes of cloths, as, hessian, bagging, tarpauling and sacking. It is also mixed with silk or used for imitating silk fabrics. Rejections and cuttings of jute are made use of in the manufacture of paper, and coarse but strong stuffs in cordage. Finer qualities are wanted for other articles mentioned above. The attempts at spinning higher counts than twenty have not been successful.

"It has been applied extensively as a substitute for hemp; for this purpose the fibres are rendered soft and flexible by being sprinkled with water and oil, in the proportion of 20 tons of water, $2\frac{1}{2}$ tons of train oil to 100 tons of jute. Sprinkled with this the jute is left for from 24 to 48 hours, when after being squeezed by rollers and heckled, the fibres become beautifully soft and minutely isolated, and thereby suited for a number of purposes unknown a few years ago.

"The history of this trade is exceedingly interesting. In the year 1820, the fibre was first experimented with, but the result was unsavourable, and in consequence, brokers were required to certify that sales of hemp and other fibres were not adulterated with jute. In 1832 an enterprising Dundee manufacturer experimented once more on the fibre, and the result was that he was able to show that it might be used as a substitute for hemp. From that date jute gained rapidly in public favour. It is one of those fibres that are capable of the most minute separation or sub-division, but only within the past few years has it been extensively used in the finer textile industries. For a long time the difficulty of bleaching seemed insurmountable, and the trouble experienced in dyeing the material appeared likely to nullify every effort to utilise it. All these stumbling blocks have, however, been removed, and there can not be a doubt that, but for the want of durability, jute would soon rank as the most valuable of all fibres. Its perishable nature, however, is fatal to its obtaining

a position much higher than it has already attained."

—Watt's Dictionary of Economic Products.

The results of the chemical and microscopic investigation of jute instituted by Messrs. Cross, Beaven and King, a few years ago, were that one sample experimented with was made to resemble *tasar* silk so closely that some care was necessary in distinguishing these substances, and another looked remarkably like wool. Before long, it should be quite possible, for the enterprising Europeans, to utilise the jute fibre for more useful purposes, by chemically altering its properties, if considerable improvement in this direction has not already been achieved.

CHAPTER XXI

COMMERCIAL CLASSIFICATION

Jute fibres are classified in trade circles according to their different qualities, such as, strength, length, colour, gloss and fineness. In fine or soft jute there is absence of roots, specks and gummy substances; while harsh jute may contain one or more of these defects. Weak or damaged jute loses its strength, and also its gloss. Jute may be divided into six classes:—

- I. Hessian—warp;
- II. Hessian—west;
- III. Sacking—warp;
- IV. Sacking—west;

V. Rejections :

VI. Cuttings.

I. Hessian-warp is a strong, long, healthy and fine jute of good gloss and silvery white colour with no specks or sticks on. This stuff is used for spinning thread which is suitable as warp for weaving hessian cloth or other finer fabrics

II. Hessian-weft is inferior to Hessian-warp in colour and gloss, but similar to it in other respects. This jute is used for weft in the hessian cloth referred to above.

III. Sacking-warp is a strong and healthy jute irrespective of any particular colour. It is coarser than the stuffs I and II. The thread spinned out of this jute is used as warp for weaving sacks.

IV. Sacking-weft is a dull-coloured short * or weak jute used for weft in sacks.

V. Rejections are the worst stuffs which are either damaged or barky or knotty used in spinning thread for sacking west. The barky jute is used in spinning after it is softened with oil and water and passed through softeners, (vide the article on European Manufactures),

VI. Cuttings are the rooty or hard portions of jute cut off from the bottom which is unsuitable for the use in the hessian cloths. Cuttings are either used in spinning sacks as weft, after being softened with oil and water as referred to above or in paper making.

* The fibre which is below 6 feet in length is called "short" jute, the usual length being from 6 to 9 feet.

CHAPTER XXII

BALED JUTE

Jute is exported from Bengal to Europe and America in bales of 400 lbs. each, pressed to the measure of 10 cubic feet, and assorted according to definite marks of the balers.

The standard quality of the baled jute market is what is known as the *M* group or 'Cracks' which belong to the jute of the Serajgunj Division. They are made up in equal proportions of No. 2's and No. 3's qualities packed separately, the No. 2's giving 40 per cent. of Hessian-warp, and the No. 3's 70 to 75 per cent. of Sacking-warp, not without a large percentage of Hessian-west in the latter.

The *M* group forms the basis of all telegraphic communications and advices regarding the market, as for instance, if the quotation for jute from Hamburg comes as £25-10, it is to be understood that it is the value per ton of *M* quality of jute at that port.

Next to the standard *M* the "Dacca" group is the most important quality in which a large business is carried on. There is always a strong demand for it. It is made of Naraingunj quality assorted into 2's and 3's similar to the standard *M*. The market value of this jute is often a little higher than *M*, say eight annas to a rupee, per bale.

The "C. D. M." grade is packed out of the medium and the common jute coming from North Bengal, and from the residue of the higher marks. This jute is largely used for sacking purposes.

The "Hearts" are low grade jute eagerly sought for by the mills which manufacture gunny bags. Its cheap price is always an inducement to buyers. It is generally used for mixing purposes.

There are some marks of fine and exceptionally good qualities in which only a limited business is done. Dundee is the principal buyer of this quality, and also France, which takes the cream of jute from Bengal.

In addition to the above there is another quality known as the 'Daisee' jute (*C. olitorius*) which is getting into favour with buyers both in Europe and India. Its importance lies in its absence of roots, which is a great thing with spinners. It is sent out to Europe in three principal numbers of 1's, 2's and 3's. The general standard is in equal percentage of 1's and 3's, such as, 10 per cent. of 1's, 80 per cent. of 2's and 10 per cent. of No. 3's ; or 20 percent. of 1's, 60 per cent. of 2's and 20 per cent. of 3's. These percentages may be illustrated by the following equations :—

No. 1 No. 2 No. 3

10 + 80 + 10 ; or

No. 1 No. 2 No. 3

20 + 60 + 20

CHAPTER XXIII

LOOSE JUTE

Jute is imported into the Calcutta Bazar, the mills and the press-houses in drums and *katcha* bales. The drums weigh 30 to 40 seers of jute each, without any particular assortment. The *katcha* bales are generally of $3\frac{1}{2}$ maunds each, assorted and pressed at the places from where they are despatched. These bales are divided into the following qualities :—

1's	Containing 80% to 90% of Hessian-warp ;
2's	" 40% of Hessian-warp ;
3's	" 60% of Sacking-warp ;
4's	" 20% of Sacking-warp ;

Rejections containing all waste.

The standard quality of loose jute market is called 50,50, that is, 50 per cent. of the bales containing 2's and 50 per cent. containing No. 3's. The price of this quality is the basis on which the prices of other qualities are determined. Of course, the price of a particular quality chiefly depends on its demand.

CHAPTER XXIV

COMMERCIAL DIVISIONS OF
JUTE TRACTS

Jute growing tracts in Bengal are principally divided into five divisions, viz :—

- (i.) Naraingunj ;
- (ii.) Serajgunj ;
- (iii.) Uttarya or Northern ;
- (iv.) Dowrah ;
- (v.) Daisee.

(i.) 'Naraingunj' jute is grown on the tracts of lands which are supplied with water from the old Bramhaputra river. There is no other jute tract in Bengal where water is so clean as that of the old Bramhaputra. The colour of the jute of this tract is the best in the market. Most parts of this tract are liable to submersion by floods when the crop is still on the fields. This standing water is responsible for the "rooty" and "mossy" fibres of this tract. High lands of this tract yield the fibres of exceptional good quality. About 30 per cent. of the jute of this tract is "hessian." Naraingunj and Chandpur are the principal markets in this tract which is under the jurisdiction of Mymensingh, Dacca and Tippera districts.

(ii.) 'Serajgunj' jute is obtained from the tract of lands which are fed by the new Bramhaputra or Jamuna river. The water of this river is nearly equal to that of the old Bramhaputra in point of cleanliness. The principal market of this tract is Serajgunj which is supplied with jute from the western part of Mymensingh and from Pabna, Bogra, Cooch-Bihar, Rangpur and Goalpara. About 30 per cent. of the jute of this tract falls under 'hessian.'

(iii.) "Uttarya" or "Northern" jute is grown in the

tract of high lands which are principally watered by the tributary rivers of the Bramhaputra. Only a limited part of this tract receives direct supply of water from the rivers. Jute of this tract is therefore steeped and washed mainly in ditch water, and as the same water is used for successive steepings, it becomes more or less coloured owing to decayed vegetable substances as the operation is continued. The colour of the jute of this tract is therefore inferior. Thirty per cent. of this jute comes under "hessian." Huldihari, Domar, Kissengunj, Kasba and Forbeshgunj are the principal marts in this tract which includes the districts of Rajshahi, Bogra, Rangpur, Jalpaiguri, Dinajpur, Maldah, and Purnea.

(iv.) 'Dowrah' jute is grown on the lands which are swamped by the branches of the river Ganges containing muddy water. This muddy water imparts a grey colour to the fibre of this tract. The "Dowrah" jute is very strong but harsh. It is principally used for sackings and cordage. Madaripur, Berhamgunj and Angaria in the district of Faridpur are the chief markets in this tract.

(v) 'Daisee' jute belongs to the species *Cochchorus olitorius*. It is grown in the high lands in the neighbourhood of Calcutta. The jute of this tract is steeped in the ditch-water supplied by the rains or the rivers Bhagirathi and Damoodar, also Roopnarain which contain muddy water during the rains. Owing to this quality of the water and some objectionable method of steeping, the jute of this tract is more or less black in colour. This jute is principally used for bagging. Badyabati in

Hooghly and Belgatchia in the 24-Parganas are the principal markets.

CHAPTER XXV

PRICES

The export of jute to foreign countries has commenced since 1828. Before this time, it is said to have "been sold at Re. 1 per maund, at its highest ; the ordinary rate was one pice a seer. Ever since that time the price of jute has been steadily rising. During 1845 the prices were recorded at Rs. 9—4 in January and Rs. 8—10 in July, per bale (5 maunds), in Calcutta. The price of picked quality reached, Rs 30/- per bale in 1882. Then there was a fall off to Rs. 25 during a short period of five years. The market again steadily rose till 1894 when the picked quality was sold at Rs. 44/- per bale. There was again a fall which continued till 1904 when the picked quality was sold at Rs. 36/-per bale. Since then the market has been again on the rise. The loose jute is commonly a rupee cheaper.

The period from August to December is the busy season of the jute trade, the first six months of the year being the dull season. Often however the market is stronger during the dull season than that in the busy season, when the stock in hand runs short, and the

demand for the fibre is still keen. The following tabular statement will show the variation in prices of jute since 1895.

STATEMENT SHOWING PRICES OF JUTE PER BALE
AT CALCUTTA MARKET
(1 Bale = 400 lbs = 5 maunds)

Year	Picked Quality		Ordinary Quality	
	January	July	January	July
	Rs-As	Rs-As	Rs-As	Rs-As
1895	32-0	36-0	30-0	34-0
1896	32-0	38-0	29-8	35-0
1897	37-0	34-0	32-0	31-0
1898	28-0	29-0	23-0	26-8
1899	31-0	31-0	28-8	28-8
1900	35-8	36-8	32-8	35-0
1901	34-0	36-8	30-0	34-8
1902	32-8	35-8	28-0	34-0
1903	37-0	35-8	33-0	34-0
1904	36-0	35-0	31-8	33-0
1905	35-0	41-0	33-0	40-0
1906	51-0	74-0	45-4	67-4
1907	81-4	73-0	58-4	45-8

CHAPTER XXVI

GLOSSARY

Terms denoting persons dealing in jute

RAIVAT—A petty Indian cultivator.

KAPALI—A Bengali sack-weaver by caste.

FARIA. } —A Petty Indian trader who goes about
PAIKAR. } from house to house and buys jute from the *raiyats*.

He disposes of it to other higher traders.

— **BEPARI**—An Indian trader who has no godown of his own. He carries on his business at the places of *mahajans* or *aratdars* for which he pays a commission at the rate of about 2 annas per maund. He disposes of this jute at local markets or despatches it to an *aratdar* in Calcutta for disposal.

MAHAJAN—An Indian trader who buys jute at markets either from *raiyats* or *farias*. He generally sends his goods in drums to an *aratdar* in Calcutta for disposal. He must have godowns of his own. If he has any *bepari* he must help him by all means. A *mahajan* is also called *bepari* by the *aratdars* if he carries on any business with them.

ARATDAR—An Indian commission agent who sells goods sent to him by *mahajans* or *beparis*, at his own discretion, if no other special agent is appointed by them, to look after their sales. The *aratdar* charges a commission generally at the rate of $1\frac{1}{2}$ annas for every maund of jute sold, besides actual godown rent. In

the Calcutta Bazar, the *bepari* pays the buyers $\frac{1}{2}$ anna per maund as brokerage, and Re. 1 per Rs. 1,000 as cashier's fee, and 4 annas per one hundred drums as *jalpani* (tiffin charge).

The *aratdar* is always responsible for the recovery of the money for goods sold. He now and then gives advances to his respectable *beparis* for which an interest of 12 per cent. per annum is charged. An *aratdar* must be a rich person.

KOVAL—A weigher.

OJAN SARKAR—A clerk who notes the weights of bundles when weightment is made.

JACHANDAR—A person who examines the quality of the fibre of every bundle to be weighed.

BALER—A jute dealer who buys loose jute and makes it up into bales of 400 lbs. each and sells his stock either to shippers or the local mills for manufacture of gunnies or gunny cloth.

SHIPPER—A merchant who exports jute in bales out of India to foreign countries.

BROKER—An agent employed to effect bargains or contracts between buyers and sellers for which he gets from the latter a commission called brokerage at the rate of 1 per cent. of the value of goods transacted. In the Calcutta Bazar he gets 3 to 6 pies per maund of the jute transacted.

UNDERBROKER—A broker who cannot approach the buyers, but effects business through a broker who allows him a share of 25 per cent. in the brokerage.

Terms denoting qualities of jute

ASHMARA—Weak stuff.

BATCH PAT—Fibre from immature plants rejected at the time of thinning.

BUKCHHAL—Barky portion of fibre at some middle places, due to plants being allowed to grow after inundation subsides.

CROPPY—Fibre having top ends rough.

FINE—Fibre of superior quality, free from impurities.

FLABBY—Wanting in firmness—loose.

FUL PAT—Immature stuff cut before flowering. This fibre is excellent in colour but somewhat weak and gummy.

KNOTTY—Full of knots. Knot is a portion of fibre agglutinated which resists separation, mainly due to an insect bite or puncture on the growing plant.

MOSSY—The low land swamped jute with numerous adventitious roots.

ROOTY—The jute is called by this name, if from the lower part of the fibre, the gum is not wholly removed, and in which the threads stick together.

SPECKY—Containing patches of outer bark here and there.

STICKY—With broken pieces of sticks or piths.

CHAPTER XXVII

PRINCIPAL JUTE MARTS AND QUALITIES*

I. Serajgunj Division :—

1. Serajgunj	11. Bulla
2. Mirgunj	12. Pabna
3. Gouripore	13. Cooch-Bihar
4. Chilmari	14. Bilasipara
5. Kallygunj	15. Mata Bhanga
6. Dewantala	16. Golna
7. Elashin	17. Northern
8. Benanoi	18. Eastern Chowrah
9. Berah	19. Western Chowrah
10. Jaffargunj	20. Deswal

II. Naraingunj Division :—

1. Naraingunj	9. Bikrampur
2. Soreil	10. Mymensingh
3. Koringunj	11. Koiriod
4. Lamjore	12. Chandpur
5. Buckrabad	13. Akaura
6. Bettial	14. Lohajung
7. Dacca	15. Janjira,
8. Dacca District	

III. Northern Division :—

1. Huldihari	4. Shikarpore
2. Jalpaiguri	5. Chilahati
3. Siliguri	6. Durwani

* Every market has its own quality.

7. Domar	13. Kissengunj
8. Saidpur	14. Purnea
9. Rangpur	15. Kasba
10. Khansama Hat	16. Forbesgunj
11. Jaipur Hat	17. Sahebgunj
12. Nilphamari	

IV. Dowrah Division :—

1. Madaripur	4. Idilpur
2. Berhamgunj or Shibchar	5. Gopalgunj-Rajoir
3. Angaria	6. Gopalgunj
	7. Goalā

V. Daisi Division :—

1. Badyabati	2. Belgatchia
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VI. Other Markets :—

1. Koostea	6. Ujainchur
2. Osmanpore	7. Khankhanapur
3. Pangsa	8. Cuttack
4. Belgachi	9. Calcutta Bazar
5. Rajbari	

The Calcutta Bazar includes the following markets where loose jute business is carried on :—

Hatkholā	Ful bagan
Ultadinghee	Bagbazar
Shambazar	

*

CHAPTER XXVIII

STATISTICS.

STATEMENT (1) SHOWING OUTTURN OF JUTE

(Add 000 for the last 3 figures omitted)

Year (From August to July)	Approximate Indian domestic consump- tion (bales)	Indian mill con- sumption (bales)	Exports (bales)	Total (bales)
1906-07	5,00		41,46	
1905-06	5,00	33,12	41,36	79,48
1904-05	5,00	31,65	35,25	71,90
1903-04	5,00	29,75	37,65	72,40
1902-03	5,00	28,24	32,53	65,77
1901-02	5'00	26,24	43,14	74,38
1900-01	5,00	24,84	35,42	65 26
1899-00	5,00	23,12	25,99	54,11
1898-99*	5,00	18,03	33,12	56,15

* Average of 6 years from 1893-94.

STATEMENT (2) SHOWING THE AREA UNDER JUTE AND
 YIELD IN BENGAL AND EASTERN BENGAL INCLUDING
 ASSAM, COOCH-BIHAR, NEPAL AND OTHER
 PLACES, AND EXPORT

[FROM 1872-73 TO 1906-07.]

Year	Area under jute in acres	Yield bales	Export in bales from August to July
1872-73	926,000	2,778,000	2,031,680
1880-81	910,000	2,730,000	1,717,982
1886-87	1,284,000	3,852,000	2,316,518
1892-93	2,135,100	5,717,400	3,083,023
1893-94	2,222,000	5,001,70	2,538,037
1894-95	2,264,300	6,144,300	3,590,056
1895-96	2,242,700	5,551,000	3,491,170
1896-97	2,196,600	5,717,000	3,293,591
1897-98	2,151,600	6,839,000	4,201,146
1898-99	1,624,400	5,334,000	2,760,825
1899-1900	1,961,800	5,412,000	2,599,472
1900-01	2,093,400	6,526,000	3,541,619
1901-02	2,263,800	7,438,000	4,314,406
1902-03	2,142,700	6,577,000	3,253,414
1903-04	2,275,050	7,241,000	3,765,752
1904-05	2,899,700	7,400,000	3,525,339
1905-06	3,181,600	8,384,600*	4,136,351
* 1906-07	3,385,600	8,883,800	4,146,369

* Nearly 150,000 bales were produced by Cooch-Bihar, Nepal and other places outside Bengal and Eastern Bengal and Assam.

STATEMENT (3) SHOWING EXPORT OF
MANUFACTURED JUTE

Year.	Gunny cloth, yards.	Gunny bags, number*
1885-67	20, 042, 036	63, 237, 923
1886-88	12, 779, 225	64, 153, 064
1887-88	13, 604, 204	73, 866, 774
1888-89	14, 979, 288	98, 720, 245
1889-90	37, 126, 737	96, 704, 220
1890-91	29, 854, 029	98, 749, 416
1891-92	37, 282, 300	106, 250, 722
1892-93	40, 060, 110	123, 974, 986
1893-94	60, 670, 094	131, 266, 827
1894-95	103, 116, 727	143, 444, 320
1895-96	114, 180, 818	168, 247, 453
1896-97	169, 410, 013	165, 945, 581
1897-98	242, 951, 051	197, 619, 914
1898-99	280, 382, 410	180, 896, 140
1899-00	307, 021, 259	168, 323, 849
1900-01	365, 214, 990	202, 908, 199
1901-02	418, 569, 614	230, 126, 651
1902-03	492, 883, 680	225, 196, 371
1903-04	552, 320, 434	206, 207, 675
1904-05	575, 511, 587	201, 436, 286
1905-06	658, 671, 353	233, 326, 201
1906-07	696, 067, 945	257, 683, 115

* These figures do not show the whole outturn of gunnies manufactured in Bengal. They do not include millions of gunnies which leave the ports of India containing grains or other produce, nor those used for home purposes or sent to other parts of India.

STATEMENT (4) SHOWING EXPORT OF JUTE (REJECTIONS
AND CUTTINGS EXCEPTED) TO ALL FOREIGN MARKETS
DURING 1905-06 (from August to July)

			bales
London	...	...	454,940
Liverpool	...	...	25,083
Dundee	...	...	1,177,293
United Kingdom other ports			2,749
Hamburg	...	...	709,938
Bremen	...	...	86,759
Fiume	...	...	75,129
Barcelona		..	48,841
Boulogne		...	156,367
Dunkirk		...	208,128
Treport		...	49,823
Genoa	...	...	84,022
Ancona	...	...	18,496
Venice	...	...	66,832
Marseilles	...	...	15,433
Trieste	...	...	168,361
Continent other ports	...		82,764
New York	...	...	161,480
San Francisco		...	18,410
Philadelphia		...	42,265
Boston	...	...	19,187
Port-land &c		...	85,411
Honkong and Japan		...	11,676
Australia	...	...	805
Other ports		...	28

Total bales 3,770,322

STATEMENT (5) SHOWING ESTIMATED AREA UNDER JUTE IN
DIFFERENT DISTRICTS IN BENGAL AND ASSAM.

District.	1872	1880	1886	1890	1895	1900	1905
	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.
Burdwan	4,000	900	...	...	10,900	11,000	14,500
Midnapore	8,000	300	...	...	11,100	12,500	10,500
Hooghly	34,600	25,000	19,000	9,700	12,000	13,300	15,800
Howrah							{ 51,000
24-Parganas	47,100	59,900	44,000	41,700	35,300	37,700	89,900
Nadia	1,000	18,600	30,000	60,000	44,000	36,000	45,000
Murshidabad	3,600	2,400	...	...	20,300	24,200	46,800
Jessore	6,405	7,700	39,000	40,400	34,100	28,600	41,300
Khulna	...	...	30,000	27,800	21,600	16,100	10,700

District.	1872	1880	1886	1890	1895	1900	1905
	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.
Bhagalpur	...	...	...	...	22,400	22,200	4,700
Burma	75,000	26,900	20,400	28,000	75,000	48,000	228,500
Darjeeling	1,500	...	...	...	13,800	2,000	2,200
Cuttack	4,208	...	...	...	4,900	5,800	10,200
Batapore	1,000	900	...	...	2,700	2,800	4,200
Jharguri	50,000	15,400	30,000	20,500	64,900	63,600	108,100
Rangpur	100,000	131,200	162,000	600,000	278,000	277,000	385,000
Dinajpur	117,600	14,600	40,000	96,000	107,500	80,000	125,000
Maldia	3,500	2,500	...	4,800	35,500	20,000	31,000
Rajshahi	14,300	25,700	45,000	118,400	103,300	107,800	128,000
Pabna	122,900	102,300	159,000	159,000	175,500	136,300	200,600

District	1872	1880	1886	1890	1895	1900	1905
	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.
Bogra	46,600	23,600	34,000	35,000	100,000	88,000	135,000
Mymensingh	84,000	160,900	250,000	301,000	558,000	519,000	705,200
Dacca	40,000	111,500	170,000	180,000	178,300	163,000	210,100
Faridpur	16,600	79,600	85,000	80,000	86,000	109,000	134,000
Backergunj	11,600	200	...	...	6,400	10,000	18,000
Tippera	78,400	...	17,000	190,806	231,200	219,000	246,800
Nowrangpur	3,600	...	...	...	9,500	1,900	4,200
Sylhet	...	...	...	...	...	...	5,000
Goalpara	15,000	15,000	16,000	18,000	20,000	24,000	27,000

PART IV—SELECTED OFFICIAL PAPERS

CHAPTER XXIX

DETERIORATION OF JUTE

BY THE AUTHOR

During the year 1898, I made an attempt to collect information regarding the best varieties of jute grown in Bengal. Accordingly I collected in Backergunj, where I was on tour, fibres and botanical specimens of different varieties of jute. These specimens, and my note on the subject were forwarded to the Reporter, Economic Products, for his examination. The Reporter, in reply, desired to get similar specimens from all other districts. Thereupon I was deputed to collect, during 1899 and 1909, similar specimens from Faridpur, Pabna, Mymensingh, Dacca, Tippera, Rangpur and Jalpaiguri.

It is said that the best fibre is obtained on loamy soil. Clayey soil gives the heaviest yield, but the plants do not ret uniformly. Sandy soils produce coarse fibre.*

It is not an easy matter to alter the physical struc-

* The Burdwan experiments with jute do not agree with this statement, as far as quality is concerned. But, undoubtedly the loamy soil is most suitable for growing jute.

ture of the soils. The exact greatness of clay and sand required for the production of the fibre of the best quality cannot be ascertained unless the soils of the localities where best fibres are obtained are mechanically analysed.

Finer quality of jute is produced on the high lands above the inundation level. The plants grown on low lands (*i.e.*, swamps) give forth adventitious roots freely, consequently the bottom fibre becomes useless for anything but paper. We can remedy it, however, to some extent, by introducing a variety which is called *Kakya Bombar* in Serajgunj. It does not produce much adventitious roots. It is said by the raiyats of Sirajgunj that this special quality of this variety may most likely be lost if the seed be not changed at regular intervals (*i.e.*, two or three years). In fact, the Serajgunj cultivators get fresh supplies of this seed from Goalpara, Assam. There are many seed-dealers who indent the seed from Assam, and sell it at Serajgunj.

Corchorus capsularis is not sown thin. The plants should be 4 to 6 inches apart from one another. This species has a natural tendency to produce more branches than the *Corchorus olitorius*. Irregular branching shortens the length of fibre. *Corchorus olitorius* is sown thin, that is, a space of 9 inches is allowed around each plant. *Corchorus olitorius* does not produce much branches. It is asserted that this variety becomes also branchy by long cultivation in the same field. There are some varieties in *Corchorus capsularis*, too,

which do not produce much branches. *Corchorus olitorius* does not grow in swamps.

Owing to coarseness in the fibre of *Corchorus olitorius*, it is always sold cheaper than the fibre of *Corchorus capsularis*. The raiyats of Eastern Bengal, therefore, do not like to cultivate *Corchorus olitorius*. The fibre of *Corchorus olitorius* is liked only by the Kapalis, the sack-weavers of Bengal. It has a peculiar yellowish colour. It is never as white, glossy, and fine as *Corchorus capsularis* is.

It is said that the late varieties, which flower very late (some flower in September), give finer and stronger fibre than the early varieties which flower generally early in July. Raiyats are not however unanimous on this point. With the late varieties the raiyats get however sufficient time for harvesting. In order to suppress the flowering period of the plants, it was suggested by the Imperial Institute authorities to nip off the flower-buds of the plants. It is not practicable, and at the same time not necessary for the late varieties, if lateness has at all any influence on quality.

The time for the cutting of the plants for the production of fine and glossy fibre is considered by the raiyats to be when the plants will shortly run to flowers,* and it has been proved to be quite true by the Imperial Institute authorities both by chemical and practical examinations. In fact, the raiyats of Pabna and Mymen-

* This jute is called *ful jute* which is somewhat weak.

† *Vide Agricultural Ledger No. 37 of 1896.*

singh begin cutting, sometimes, about a month before the plants would run to flower, i. e., after the plants have grown at least for a period of three months. But generally raiyats like to wait some time longer in order to get heavier yield of fibre. The later it is cut, the heavier outturn is believed to be obtained by the raiyats. But Mr. T. N. Mukerjee's experiment at Rahuta shows that heaviest yield is obtainable from the plants cut just after budding. Mr. Mukerjee's experiment may be verified by further experiments.* The Ledger referred to does not show which variety was experimented with by Mr. Mukerjee. It was perhaps *Cochrinos olitorius*. However, the raiyats of Eastern Bengal finish cutting before the fruits are ripe, in order to get the best result.

The influence of steeping water on the colour of the fibre is great. Clear stagnant water is the best for this purpose. Retting does not proceed uniformly in running water. Muddy water imparts black colour to the fibre.

The chief cause of deterioration of the jute fibre is perhaps due to the continued cultivation of the crop, year after year, on the same field. It has been observed that the best quality of the fibre is obtained from the fields which are newly broken up, or the fields on which jute is rotated with some other crops. But the raiyats cannot generally wait.

Where it is convenient and available, cowdung is used as a manure for jute. But in many cases there

* Our experience corroborates that of the raiyats.

are no means to carry off the bulky manure to distant fields. The quantity of the dung when supplied is generally too small for the purpose, for the stock of cattle of a raiyat is but limited. It is well known to the raiyats that even the seed of the best variety sown on poor soils produces short staple. On the poor soils the plants flower much earlier, to the detriment in the length of fibre. Farm-yard manure will not be available in sufficient quantity, and in many cases, as already reported, it is not practicable to use it. Some chemical manures are therefore necessary. Saltpetre * (nitrate of potash) may prove most useful. Experiments in each typical locality are necessary to ascertain the suitable manures and their quantities to be applied most economically.

The chief cause of the deterioration of the fibre as regards its strength and colour, is due to the cheating habit of the *farias* (petty dealers) who purchase the fibre at higher prices and sell it at lower. They sprinkle water into the fibre in order to get its weight heavier. In extreme cases the fibre is altogether destroyed, and a great loss is sustained by merchants. I have found some jute containing over 30 per cent. of moisture.† This sort

* Unfortunately the results of the experiments with jute at the Burdwan farm show that saltpetre, super or bonemeal are not suitable manures for jute. Next to cowdung castor-oil-cake has been proved to be the best.

† This I mean above the normal moisture about 10 percent. contained by the fibre in the atmosphere of the season which is, of course, very wet.

of unfair dealings must be stopped, and it lies principally in the hands of the merchants themselves. They may offer a higher price for a good dry fibre, and reject the wet jute.

To sum up my suggestions for the improvement in the quality of jute :—

- (1) Rotation.
- (2) Judicious manuring.
- (3) Interchange of seeds.
- (4) Cultivation of selected varieties or races of jute.
- (5) Fairness in the trade.

CHAPTER XXX

COMPOSITION OF WATER USED FOR JUTE STEEPING AT THE BURDWAN FARM

By J. Walter Leather, PH.D., F.I.C.,
Agricultural Chemist to the Government of India

I have the honour to submit to you my report on the amount of iron present in the samples of water which has been used at Burdwan for steeping jute during the past season.

2. In paragraph 3 of letter No. 183, dated the 23rd October, 1901, Mr Lyon refers to the suggestions

that the steeping water contains iron, which may occasion a discolouration of the fibre.

3. I have therefore determined very carefully the quantity of iron present in the waters which have been received from Burdwan, and, as the statement shows, some of the samples contain a small quantity of dissolved ferric oxide. None of them contained any ferrous oxide. The amount of iron present is very small. '1 pt. per 100,000 is equivalent to '07 grain per gallon. Whether such small quantity can affect the colour of the fibre is a question which I cannot answer. A comparison of the specimens of fibre which have been produced may enable you to form an opinion, and I should feel much interested if the result of such a comparison may be communicated to me.

4. I have left out of consideration all iron which may be present in the silt of such waters. All such silt naturally contains iron, but in an insoluble state. It is true that in the process of steeping some part of this might conceivably become dissolved and then affect the fibre ; but when one bears in mind that most, if not all, of the water used throughout Bengal for this purpose contains silt, it is highly improbable that the iron of such silt affects the fibre.

5. Other constituents of the waters have not been determined. There seems to be no evidence that the salts, which are natural to such waters, can affect the fibre. There is no chemical reason for such an assumption that I am aware of, and, secondly, if the steeping

water were affecting the fibre, there should be evidence that damage occurs in specific localities. I see no mention of this in the papers which have been forwarded to my office.

CHAPTER XXXI

EXPERIMENTS WITH JUTE AT THE BURDWAN FARM DURING THE YEAR 1902

BY THE AUTHOR

I beg to submit herewith the register of the experiments with jute at the Burdwan Farm. It contains details about the experiments. I was put in charge of the general supervision of the experiments. The experiments were visited by me once a week. I could not always look after the stripping operation, which would have required my constant presence there. This work was entrusted to an old farm servant. The steeping process was similar to that of Eastern Bengal. I did not approve of the local system of covering the heaps of jute plants under retting with sods of earth which certainly discolours the fibre to a certain extent. It is required to give weight to the heaps for sinking. In Eastern Bengal several layers of bundles of jute are placed one over another, which

does not require any artificial weight, while in Hooghly and its neighbouring districts only two layers of bundles are heaped together, as the water available for steeping is generally shallow.

The harvesting operation extended over three months from early August to the end of October.

The temperature of heaps during the retting process was taken; 80° F. was the minimum, and 95° F. was the maximum. The temperature fell considerably (83° maximum) towards the end of October. The temperature in large heaps was always 10° higher than that in small ones. But at the time of raining the temperature in all the bundles was constant.

There were 15 varieties of jute grown from the seeds collected from different jute-growing districts. We added to them the Serajgunj seed selected on the farm for about 12 years last. Of all these varieties, the farm seed appears to have done the best. It appears that the farm seed came originally from the variety "Deswal" of Serajgunj. It may be noted that by careful selection, the farm seed has improved. Considering all points, however, I am of opinion that "Boran" Mymensingh should be the best for high-lands, and "Kakya Bombai" of Serajgunj for the low-lands. Serajgunj "Deswal" appeared, however, to be stronger than either of the former two varieties. The "Barapat" of Serajgunj was found stronger and earlier than the three varieties mentioned above. The yields of the fifteen varieties of jute of different districts are not com-

parable, as the plots sown were too small. Moreover, all the varieties were more or less mixed with one another.

The thick sowing and thin sowing experiments were conducted on loamy soil with the farm-selected seed manured with bonemeal containing 30 lbs. of nitrogen per acre.

The crop of the thick and thin-sown plots were cut at two stages, viz., (i) in flowers and (ii) in fairly set fruits. The plants were fit for cutting at the second stage only after 10 days of the first cutting. The change was very quick.

It was not possible to draw any conclusion regarding the best stage for cutting in order to get the heaviest yield. We expected to get it from the plots of potato series, cutting at different stages. But the manures applied to the preceding crop might have affected the results. We are, however, convinced that the heaviest yield is procurable when the plants are cut in fruits.

Manure experiments with jute undertaken during the year under reference failed owing to water-logging. In fact, all the experiments were started too late, and the drainage was bad.

The steeping water of the farm was not favourable to get a first class fibre, as is obtained in Mymensingh. The water contained little iron as shown by the Agricultural Chemist, but other colouring matters from the decomposition of vegetable substances were present.

The jutes of the variety experiments were more or

less over-retted. It is due to the fact that the samples* were too small to get retted uniformly. It was found that some parts of the fibre of a variety were specky with bark on, while other parts were too soft owing to over-retting. It is required to cultivate the varieties on larger scales in order to get the fibres of a definite standard.

Time required for retting varied from 15 to 30 days. The smaller heaps took generally a longer time in retting than the larger ones, although steeped on the same day. The *shewla* (a kind of very small water weed) appeared in the beginning of September, which interfered very much in the retting of small bundles wanted for the Agricultural Chemist.

Mr. D. N. Mukerji and I were present when the samples of jute were examined by three European jute merchants, at the instance of the Calcutta Baled Jute Association. The fibres were judged by their colour, lustre, length and strength. From the judgment it does not appear that the cutting of plants at a certain stage of the growth has any influence on the quality of the fibre. But the raiyats of the principal jute-growing districts are generally of opinion that the finest jute is obtained if it be cut at about the flowering stage. These gentlemen expressed themselves that the distribution of good seed would be all for the improvement of jute in Bengal. There may be no question whatever about it. But, without systematic manuring or rotation of the

* The yield of fibre of each variety was about 7 lbs. only. §

crop, good seed alone would never bring about satisfactory results.

As suggested by the Inspector-General of Agriculture in India, seeds of different varieties have been saved. But water-logging has caused considerable injury.

CHAPTER XXXII

EXPERIMENTS WITH JUTE AT THE BURDWAN FARM

BY D. PRAIN, M. A., M. D.,

Superintendent of the Botanic Garden, Sibpur

After visiting the Burdwan Farm and carefully examining the sample experimental plots, I am of opinion that the experiment has been carefully thought out and is being carefully conducted. It is too soon to say yet this season what the full deductions from the experiments are to be. My visit, which was paid at the request of Mr. Maddox and not primarily in connection with the present reference from the Government of India, was paid in company with Mr. Burkhill, who was, I understand, independently under an obligation to pay a visit to the experimental farm. I hope to pay another visit and further hope that I may be able to pay it along with Mr. Burkhill.

As regards the experiments themselves, I have but one minor criticism to offer. A point to bring out clearly is the extent to which the plants in these plots are subject to cross-fertilization owing to their being grown in proximity and consequently to what extent the plots of a second year show, as compared with those of the year before, an increased proportion of plants of mixed type. I should expect this to be considerable. On examining the actual second-season plots at Burdwan it struck me as wonderfully small. I was, however, informed that when the plants were small and the various plots were being weeded plants of obviously mixed type were, as far as possible, eliminated. So far as one phase of the experiment is concerned, I realize that this was essential. But I should have liked to see, and had I been consulted earlier, would have recommended, that a small section, say a piece as long as each plot is wide, be left rigorously alone—weeded to be sure, but with all jute plants of whatever type it might contain, left to grow. The plants would probably have been too thick to serve any other useful purpose, but they would have served to indicate the extent to which the crossing of races takes place. So far I can find no sign that there are any varieties either in *Corichorus capsularis* or *C. olitorius* though there is apparently a considerable tendency to racial modification, especially in the former species.

As to the general question of deterioration it is not clear that this occurs. It is asserted : there is no attempt

at proof. I have a vivid recollection of Experimental Jute-growing on the Sibpur Government Farm some ten years ago and the similarity between the plants seen by me at Burdwan this year and at Sibpur then is most striking. If there be anything in the complaint the whole tendency of the statements before us is to show that the deterioration lies in more careless retting, not in a demoralised plant. If so, the remedy should be with the trade.

The report submitted by the fibre experts is the most disconcerting document of the whole series to my mind. It has been evidently drawn up with the greatest care, yet it proves nothing and affords little real assistance to Government. There are several possible explanations of the results of this report, none of them entirely satisfactory to my mind. It seems unnecessary at this stage to discuss them exhaustively. I will, however, indicate the two that appear to me to be most plausible, yet these two being more or less alternatives do not help us much—(1) It may be safely assumed that the whole of the plots were last year grown, harvested, and retted with equal care. It is certain that the plants in all the plots grew under quite comparable conditions. Yet the results, which may be termed good, as regards Deswal jute raised from farm seed, were indifferent to fair only with the most of the other kinds. The suggestion, then, is that seed of a strain natural to, or naturalized in, a particular district gives better results in that district than any freshly imported

seed. If this be the case, the experiments at Burdwan, however prolonged, will not lead to the results that Government and the jute industry wish to obtain. They will have to be repeated in every *likely* jute-producing tract.

(2) It may, however, be supposed that the jutes from other districts grown at Burdwan were really quite as good, as these same strains are capable of being in their own districts. It may even be anticipated that in some cases the change of venue really benefited them. If this is the case, it is not impossible that those in charge of the retting and extraction of fibre at Burdwan being most familiar with the jute that had become so to speak naturalized at the Burdwan farm, get better results from it than was possible from *identical* treatment of the other strains of jute. If this possibility could be proved, the remedy would be to get men from the districts where these particular jutes are naturally grown to go to Burdwan and treat as they annually treat them, the jutes they are accustomed to. This particular method of overcoming a difficulty is known to and practised on a large scale in certain places by the native raiyats themselves. The following instance, which is a familiar one, illustrates the point. In the beginning of the nineteenth century hemp was grown in the Jessore district for the purpose of producing *round ganja* for the Calcutta market. In North Bengal, hemp was only grown for the purpose of producing *flat ganja*. When the Board of Revenue, Lower Provinces,

concentrated the cultivation of hemp for the purpose of producing *ganja* in the present *ganja* mahals round Nowgong and in the adjacent parts of Rajshahi, Dinajpur, and Bogra, obviously *round ganja* for the Calcutta market could only be manufactured in the restricted area. But the people about Nowgong did not know how to make *round ganja* for the Calcutta market: they therefore introduced at the harvesting season Jessore coolies to make it for them. Now though three-quarters of a century have elapsed since any hemp was grown for *ganja* making in Jessore, the Nowgong people to this day import Jessore coolies to make their *round ganja* for the Calcutta market, making the *flat* themselves as they have always done.

What the raiyats of a particular area can do every year for the special purpose, it is possible that Government might do for one or two years for a parallel purpose—the preparation of a fibre such as is known to suit the Calcutta jute-buyer.

CHAPTER XXXIII

JUTE EXPERIMENTS AT BURDWAN

BY I. H. BURKILL, M. A.,

Reporter on Economic Products to the Government

Section 1.—Corchorus capsularis.—I was quite

convinced in my mind after my visit to the Burdwan Experimental Farm in August 1902, and subsequent study of the specimens preserved in my office, that *Corchorus capsularis* breaks up into no botanical varieties, but that it has many races perhaps more or less conspicuously wanting in permanency. The very multiplicity of vernacular names for different forms rather indicates this, and the jute merchants have never done more in the direction of distinguishing kinds than use place-names.

Last year at Burdwan I noticed how freely insects (particularly the wild bees of the genus *Apis*) visit the flowers and fly from plant to plant. This year I confirmed the observation ; and I find that from about 7-30 A. M. when jute flowers open until late in the day, when they wither, they are constantly visited by a variety of bees. The flowers last but the one day.

Cross and self-pollination are both effected by the visitors. It would be so contrary to the law of nature for a plant to be insusceptible of cross-fertilisation that I have not tried to prove that cross-fertilisation occurs. I did, on the other hand, experiment with regard to self-fertilisation by wrapping up buds in fine linen, and though I only obtained eight fully-ripened capsules out of the 31 flowers which were wrapped up, the possibility of self-fertilisation was proved ; I prefer to think that, to the rain, which soaked the wrappings, almost as soon as I had put them on, was due the failure to set seed of the other flowers and not to self-sterility.

The reverse would, however, strengthen the argument which follows. The bees going from flower to flower are consequently doing much to frustrate the endeavours of those who have charge of the Experimental Farm to keep their races pure, thus, for instance, the race *Baraput* has twice been grown between plots of the races *Baran* and *Kakria Bombai* and is exposed to the possibility of fertilisation from both as well as from more remote plots.

The abundant opportunities for cross-fertilisation which occur where the different kinds are grown close together accounts for the variation which was seen before the plots were thinned in the second experimental sowing made in 1903 at Burdwan. The opportunity which thinning afforded was used by Babu N. C. Chaudhuri, who has been in charge of the experiments to get rid of plants not true to type and to that only is due the nearly general uniformity of each plot.

As he has undoubtedly set his ideals nearer to him than the cultivator does, his plots are more uniform than the crops will be found to be in the country.

There are hardly any naked-eye features that one can seize on whereby to distinguish the races of jute except the colour of the stems and leaf-stalks, the time of flowering, and the height that the plant attains. The only one of these characters serviceable at thinning time is the first; and on it as a test the weeding of the crops at Burdwan has been done. Consequently it follows that the race *Baraput* grown between a race with

red-petioles and another, having, like it, green petioles but beginning to flower a little later, will have weeded out from it the mongrels showing a strain of the red-petioled *Kakra Bombai*, but not those which are the offspring of it and *Baran*.

It is to be expected, therefore, that if on the closely approximated, experimental plots at Burdwan such an experiment as the present one be prolonged for several years, the individuality of the races will be gradually reduced. There will, however, be a tendency to break them up into two classes, *viz.*, red-stemmed and green-stemmed, according to the selection practised in thinning the plots.

Do the raiyats actually use the colours red and green in any way to weed out undesirable plants? I note that the Rangpur races are particularly red-stemmed and that the Faridpur races all have red petioles on green stems.

In the country, plots are larger and less approximated; the liability to the production of mongrels is therefore much diminished. It will be at once asked how the races come to be retained. I believe chiefly because each district grows early, mid, and late-flowering races and it seems to me that such an idea should form a good working hypothesis upon which to gather information. A common period is, however, not kept by the races in different districts, but the tendency is evidently for the plant in the northern districts to become quicker-growing than in the southern districts,

Facts are wanting which might show any connection between the general lateness of the local races of jutes and the degree of submersion to which the district is liable. The Burdwan experiments have shown that the Jalpaiguri and Jamalpur races are particularly early-flowering.

The experiment suggested by this observation is that the behaviour and value of the best Jalpaiguri races should be tested in the neighbourhood of Serajganj, or in Tippera, Faridpur, and Dacca, which are districts sending the latest kinds to Burdwan; and the reverse should also be tried. It may perhaps be found that imported seed is an acquisition in one or the other place.

I observed at Burdwan that two plots of plants produced flowers paler than usual. These two were "*Tosha red*" from Serajganj (why named red, I do not understand) and *Fulleswari* from Tippera. The only difference between the two, as far as I have observed, is that *Fulleswari* was found to be a little later a little shorter at the dates of my visits. The Burdwan Farm received another kind of jute from Tippera named *Dewdholi*. *Dewdholi* and *Fulleswari* were the only two Tippera jutes. My notes tell me that *Dewdholi* had exactly the same relation to *Kakaya Bombai* from Serajganj that *Tosha red* had to *Fulleswari*.

It is by no means improbable that seed of *Kakaya Bombai* and *Tosha red* from Serajganj and sown in Tippera would in a few generations become *Dewdholi* and *Fulleswari*; brought back again in a few more

generations they would return to *Kakya Bombai* and *Tosha*. The Burdwan Farm received under the name of *Parbata* seed from two sources, viz., Jamalpur and Dacca. The Jamalpur plot flowered a little earlier than the Dacca plot ; in other respects they were the same.

If I am right in thinking that the locality does, in a few generations, tend to delay or hasten the growth as suggested above, then this influence will act together with the cross-fertilisation in levelling the Burdwan crops, if they should be grown through a fairly long series of years.

I unhesitatingly state that—

“*Tosha red*” (Serajganj) = *Fulleswari* (Tippera) made a little later.

Kakya Bombai (Serajganj) = *Dewdholi* (Tippera) made a little later.

Parbata (Jamalpur) = *Parbata* (Dacca) made a little later.

Barapat (Jagannathganj) = *Barapat* (Serajgnj).

I suspect that without difficulty other cases could be established ; but to do so would mean an intimate study of the plant in the field. Information in this direction could be collected by the travelling Overseer of the Department of Land Records and Agriculture, Bengal.

The Jute valuation made last year by Messrs. Millar, Duffus, and Dott of the samples from the small experimental plots told us only one thing really, viz., that of all the races grown together none was distinctly better or worse than the average of the lot ; while of the plots grown elsewhere on the farm the jute fibre

from many was better than from the selected races. This year instead of 11 small experimental plots there have been 36. I am very anxious to know if there is to be the same uniformity in the value of the produce that there was last year. What will be most instructive perhaps from out of the whole series will be the value of the produce of plot No. 16 "Farm seed."

Much depends upon that and I could wish that a plot of "Farm seed" had been sown, say, between every five of the long series, the ground given to which seemed to me to be poorer at one end (towards No. 45) than at the other end.

Section 2.—Corchorus olitorius.—I tried the same experiments with *Corchorus olitorius* as with *Corchorus capsularis* and obtained the same result. I had 28 capsules wrapped in linen and obtained 9 pods. The seeds from these pods sown on a damp tile in my office are now germinating very freely. The flowers of *C. olitorius* are larger than those of *C. capsularis* and are visited by the same insects. Their duration is one day, and pollen is shed around an apparently mature stigma at the moment of the opening of the flower. There is, therefore, the same chance of cross and self-fertilisation in this species as in the other. However, the races are much fewer. I classify them—

No. 1 early green-stemmed called *Satnala* in the Faridpur district and *Bangi* in Dacca;

No. 2 late green-stemmed, which came as *Nailta* from Jagannathganj, *Deswal* white from Serajganj and *Paknallya* from Jamalpur;

No. 3 very late green-stemmed which came as *Dewnallya* from Dacca ;

No. 4 late red-stemmed received as *Tosha* from Serajganj, and as *Desi lalpat* from Hoogly ; also probably here is to be added *Halbelati* from Tippera.

It is remarkable with regard to the valuation of fibre made last year by Messrs. Millar, Duffus, and Dott that they remark of both *Tosha* and *Desi lalpat* that they had stood too long in the field—a remark that they do not make of the early *Satnala* and *Bangi*. They also remark of both the latter that they had soft ends—remarks which confirm my classification by appearance of the plant.

Altogether the problem of improving the races of *C. olitorius* is infinitely less complex than that of *C. capsularis*.

CHAPTER XXXIV

VALUATION OF FIBRES PRODUCED AT THE BURDWAN FARM

BY D. N. MUKERJI, M.A., M. R. A. C.,

Assistant Director of Agriculture, Bengal

(I) There is little or no difference among the different samples in regard to strength. This was due to the fibres being dry : (the weakness of the fibres, it was verbally

explained to me by the jute experts during the examination, was caused by artificial and fraudulent watering). There must in the very nature of things be difference in strength between one sample and another, but apparently such difference is a negligible quantity for practical purposes.

(2) As for the other *characters*, e.g., colour, fineness and absence of roots, it is doubtful (at least in many cases) how far the difference among the different samples is real or characteristic of the varieties, and how much is due to defective steeping. We shall be able to speak with more confidence on this point next year when we propose having men from the jute districts for steeping.

(3) It appears that well-grown jute is better than stunted jute. The difference is entirely due to the greater length of the former. There is no difference in fineness between the two (*vide manure experiments*).

(4) Cutting the plants when fruits have set is decidedly better than cutting them later. This agrees with previous experience.

(5) Different degrees of spacing the plants apparently has had no effect in improving the seed. This perfectly accords with my own ideas on the subject of seed selection. The principle is that the best individual plants (depending upon whatever character we choose as our object) should be selected for seed. I believe it is now an established fact in physiology that accidental advantages or disadvantages of the parents never influence the offspring. And spacing or manuring are mere accidents.

If, therefore, we go in for seed selection, we must deal with individual plants and not with entire plots or fields, however treated in the lump.

(6) The spacing experiment did not tell so far as the quality of the fibre went. This greatly simplifies the question which turns apparently on *outturn* of fibre only.

(7) I will not at present go into details as regards the varieties or races. One point, however, is abundantly clear, namely, that *capsularis* is by far a better fibre than *olitorius*. No. 23 of the variety experiment, for instance, was *olitorius*, but the fibre was the best of its kind, yet the price was no more than Rs. 5-12 against Rs. 6-12, or even Rs. 7 given against the best samples of *capsularis*. Even comparatively poor varieties of *capsularis* were appraised at a much higher figure than the best sample of *olitorius*. This does not very well fit in with the idea that prevails in very high quarters to the effect that the recent deterioration of jute is due to the extension in the cultivation of *capsularis*. This point is most important.

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CHAPTER XXXV

DETERIORATION OF JUTE

By J. W. MOLLISON,

Inspector-General of Agriculture in India

THESE papers contain information which I will

endeavour to epitomise. I will also criticise statements and conclusions which I consider wrong and misleading.

2. There is clear proof that the alleged deterioration of jute in Bengal is due to malpractices after the crop is reaped and retted, rather than to degeneration of the plant. Degeneration of the plant may have occurred in some races, but there is no proof that this has ever happened. The best races now cultivated yield excellent crops if liberally treated and excellent fibre if it is properly extracted.

3. No botanical varieties of either *C. capsularis* or *C. olitorius* were found by Mr. Burkill among the numerous races which were grown experimentally at the Burdwan Farm. The races of *C. capsularis* are more numerous than of *C. olitorius*. The former particularly are conspicuously wanting in permanency. This is due chiefly to free cross-fertilisation caused principally by insects.

4. The various races of *C. capsularis* and *C. olitorius*, as grown experimentally at Burdwan, showed differences—

- (a) in date of flowering ;
- (b) in height of plants and general vigour of growth ;
- (c) in the colour of stalks and leaf stalks.

Mr. Burkill noticed two plots of plants *C. capsularis* which produced flowers paler than usual.

5. The differences noted under (a) and (b) are probably due to—

- (i) cross-fertilization ;

- (ii) local conditions, such as season of sowing, depth of water, etc.;
- (iii) acclimatization.

6. In 1902 and 1903 the plots of red-stemmed and green-stemmed varieties were promiscuously arranged, and all the plots closely adjoined each other. There were therefore free opportunities for cross-fertilization.

7. It is usual to sow jute seed thickly and weed out superfluous seedlings at an early stage of growth. When this weeding was done at Burdwan the red-stemmed or mongrels plants were removed from the plots of green-stemmed races, and green-stemmed or mongrels plants were similarly removed from the plots of red-stemmed races. It has been arranged that in 1904 the whole of the seedlings, which grow on a small portion of each plot, will be left to grow to maturity in order to determine the extent of cross-fertilization which has occurred.

8. Mr. Burkhill thinks if the experiments at Burdwan, as now arranged, are continued for several years, the individuality of races will be gradually reduced. From an agricultural point of view it is most advisable that individuality should be preserved when it represents, as in some of the races, characteristics which are valuable. The Burdwan Farm is small, and only a limited area can be given to jute. It is therefore impossible to prevent cross-fertilization there, if a large number of races are grown.

9. It is, I consider, essential that a Botanist should identify each Bengal race of *C. capsularis* and

C. olitorius. The stability of each race can be afterwards determined. Pure seed of each should be obtained for cultivation in isolated plots. A start has been made at Pusa in the current season. The Director of Agriculture, Bengal, supplied 40 small parcels of seed obtained from the Burdwan Farm plots and from out districts. The seed has been sown in isolated plots with rice between. Every effort will be made—

- (a) to weed out before flowering all stray plants ;
- (b) to note the characters of each race ;
- (c) to obtain pure seed of each for sowing larger isolated areas in the following season.

The Director of the Pusa Agricultural Research Station will be told to ask for advice and assistance from the Director of the Botanical Survey. In 1905, I hope, all the identified races of *C. capsularis* and *C. olitorius* will be grown at Pusa.

10. The races were grown at Burdwan in 1903 on 45 plots. The plots were similarly manured. The crops on plots 1 to 27 were generally better than on plots 28 to 45, owing probably to different cropping antecedents. The outturn results therefore cannot be critically compared. The seed was sown on 31st May. Eight plots were harvested on the 15th August, and the remainder between 29th August and 9th September. Mr. D. N. Mookerji in his note, dated 6th November 1903, gives a tabulated statement which is intended to show that late ripening races gave the greatest outturn. If the outturn figures, plot by plot, are examined, it will be seen

that, independent of the time of ripening, races from some districts yielded better than those from others. I cannot therefore accept Mr. Mookerji's conclusion at this stage.

11. The valuation by jute experts of the 1903 Burdwan farm samples is exceedingly interesting. Taking these valuations and actual outturns into consideration, the races referred to in the following tabulated statement should claim special attention in future :—

Plot No.	Name.	District.	Date of ripening.	Outturn per acre.	Value per m. m. a.	Value per acre.
1	2	3	4	5	6	7
<i>C. euphorium</i>						
16	Deshal Srirangaj	Do. 311	30th August	2,502	6 12	211
4	Ditto new seed	Do.	29th	2,017	5 10	174
3	Kakva Bombar	Do.	"	2,157	6 6	172
17	Agniswar	Do. 1	30th	2,561	5 4	168
18	Belgachhi	Do.	31st	2,541	5 5	169
19	Bidva sundar	Do.	31st	2,219	5 10	156
20	Deshi	Do.	31st	2,319	5 10	163
21	Deshi Nalya	Do.	31st	2,480	6 0	186
22	Dhal sundar	Do.	31st	2,319	6 2	177
24	Kajla	Do.	1st September	2,581	5 4	168
25	Patibata	Do.	1st	2,319	5 8	159
31	Deshal, Pabna	Pabna	9th	2,037	5 9	141
36	Dew dhal	Tippera	2nd	1,505	5 8	103
37	Fulleswar	Ditto	2nd	1,512	5 10	106
45	Bhadrak	Jalpaiguri	2nd	1,775	Not valued.	
<i>C. olitorius.</i>						
7	Tosha*	Pabna	9th September	2,420	5 12	173
12	Deshi lalpat	Hooghly	9th	2,177	5 13	156
23	Dew nallya	Dacca	9th	2,661	5 12	191
29	Naitla	Mymensingh	1st	2,016	5 10	141

12. It is uncertain whether the Burdwan plots produced fibre which was as good, better or worse than that ordinarily produced by the same races in their own districts. Until pure seed of each race is available and each race is cultivated under varying conditions of soil and climate, we cannot venture to recommend extensive cultivation of any particular race or extensive interchange of seed between districts. There is evidence to prove that the Desal Sirajganj race of *C. capsularis* is a very good variety, and that selection and acclimatization at the Burdwan Farm has kept it up to a high standard or improved it, but until we determine the effects on other races of—

- (a) local conditions on interchanged seed,
- (b) acclimatization,

we cannot authoritatively state which are best for general cultivation.

13. The same kind of jute, viz, Desal Sirajganj, was grown on plots 16 and 4, which for comparison are entered at the top of the tabulated statement of paragraph 11. The seed sown on plot 16 had been acclimatized and selected for 13 years on the Burdwan Farm whilst that sown on plot 4 had been newly introduced. The acclimatized seed gave a better outturn and slightly better quality of fibre. The fibre from each plot is valued higher than that of any other plot of the whole series. The valuations range from Rs. 5-4 to Rs. 6-12 per maund. The difference in a good crop between the highest and the lowest valuations amounts to about Rs. 40

per acre. The lower valuations may be due to inferiority of the fibre of some races, to local conditions unsuitable to the cultivation of some races, or to defective, steeping and retting. It is very important to determine which cause is responsible. The problem as regards defective steeping and retting can be solved in the forthcoming season by providing a suitable tank and by bringing in experts to do the work from the districts concerned as proposed by Major Prain.

14. The plots at Burdwan which were devoted to experiments in testing—

- (a) manures,
- (b) cutting at different stages of growth,
- (c) selection of seed,
- (d) spacing experiments,

were all sown with acclimatized Desal Sirajganj seed. The samples of fibre were valued at Rs. 6-4 to Rs. 7 per maund, excepting one sample obtained from dead ripe jute which was valued at Rs. 5-12. These figures show that the Farm men are experts in steeping and retting jute of this class, and it may be found that when a proper tank is provided at Burdwan, they can extract the fibre properly from any race of jute. Very favourable results in steeping and retting at one centre may not, however, in practice be made to apply to another. Jute, when harvested, is such a bulky and heavy crop that it cannot be carried far. The water which is most convenient must be used. The extracted fibre from a good crop may weigh as much as a ton per acre.

If the quality and colour of this fibre can be improved by washing in clear running water and by bleaching and drying in the sun, the cost would not be prohibitive in some districts. Experiments will be carried out at Pusa.

15. It has been stated, but not proved, that red-stemmed races give inferior varieties to green-stemmed races. There is equal doubt as regards the comparative values of the fibre of *C. capsularis* and *C. olitorius*. It is possible that the best races of *C. capsularis* produce more valuable fibre than the best races of *C. olitorius*, but the Burdwan experiments have not yet definitely proved this. If the valuations and outturn figures in the tabulated statement of paragraph 11 are examined, it will be found that the best races of *C. olitorius* do not compare very unfavourably with those of *C. capsularis*.

16. It has been asserted that sandy soil produces coarser jute than loamy soils. This is not borne out by experiments at Burdwan. Very good jute can be grown on fairly high land in Bengal, provided the cultivation is liberal and there is sufficient water or dampness during the whole period of growth. The actual character of the soil is of minor importance.

17. The Burdwan experiments clearly show the value of liberal cultivation and also, I believe, of rotation of crops.

18. The experiments in spacing *i.e.*, thick and thin sowing and thinning out have not given conclusive

results. Mr. D. N. Mookerji explains that it is difficult at Burdwan to get evenness of distance between plants when seed is broadcasted and when seedlings are thinned out by hand. If the field labourers are properly directed at work there should be no practical difficulty in leaving seedlings approximately, say four or six or any other definite distance apart. Drilling might be tried as suggested by Mr. Mookerji (a drill of the common pattern used for indigo might be found suitable). I do not think, however, that greater accuracy in spacing would thus be secured. There are, moreover, practical difficulties in working a drill in rice-beds. Seed can be successfully broadcasted, especially in rice districts, when the conditions would be unsuitable for drilling. I need not enter into details.

The experimental results indicate, if they do not actually prove, that thin seeding and severe thinning out give—

- (a) strong or thick plants which yield more fibre per acre and when ripe better seed than the plants of a thickly-sown crop,
- (b) labour is saved in extracting the fibre from the thick plants, as after steeping the bark is easily stripped off,
- (c) the fibre obtained from thick plants is not appreciably inferior to that from thin plants.

19. Mr. D. N. Mookerji in his note of 3rd March 1904, suggests that spacing experiments can have no

influence on seed improvement. This should not be admitted. It is at least conceivable that a crop which is thinned out so that each plant grows fairly vigorous and strong will produce, if allowed to properly mature, better seed than the weakling plants of a thickly-sown crop. If this can be proved, ordinary cultivators can, I think, be induced to grow seed in this way. Such seed, if winnowed properly, will at least be sound and better than that usually sown. A better system of selection is to gather year by year the best seed from the best plants. This process of selection is slow. The quicker but less sure method above referred to should not be neglected.

20. It is commonly believed that the latest ripening jutes produce the best fibre. This has not yet been proved by the Burdwan experiments.

21. There is clear proof that jute should be cut for fibre before it is dead ripe, but the experiments have not determined the exact state of growth at which the plants should be cut to yield the most valuable fibre. Harvesting should not be delayed after the fruits set. Reaping may possibly be done early with advantage, but this has not been proved.

22. The practical examination by the jute experts of the various 1903 samples determined little or no difference of fibre which reduces the price of commercial sample is caused by artificial and fraudulent watering which induces heating and causes discolouration and rotting.

23. Well-grown jute yields more valuable fibre than stunted jute because of the greater length. It does not, however, appear from the valuation of the experts that extra length adds very materially to the value of commercial samples.

24. Mr. Burkhill thinks that the Burdwan experiments indicate that there is a tendency for the races of jute to become quicker growing in the northern districts of Bengal than in the southern, and hints that there may be a connection between the general lateness of local races and the degree of submersion to which the district is liable. He further suggests that interchange of seed of the best races should be arranged for between Jalpaiguri and Mymensingh, Tippera, Faridpur and Dacca. The Burdwan races which flowered latest were obtained from the last four districts. A statement will be found in the papers which gives the dates of harvesting and the yield of fibre per acre and the valuation of the fibre of each race grown at Burdwan. A careful study of the statement will show that early ripening varieties and later ripening varieties are not confined to particular districts, and, taking all circumstances into consideration, we are by no means in a position to say how interchange of seed between districts should be arranged for.

CHAPTER XXXVI

JUTE EXPERIMENTS IN 1904

BY D. N. MUKERJI, M. A., M. R. A. C.

THE objects of the experiments were to answer the following questions :—

- (a) Whether the quality of the fibre varies with the kind of jute sown.
- (b) At what stage of growth a crop should be harvested to give the best fibre.
- (c) Whether a well-grown crop resulting from suitable manuring gives a better fibre than an inferior crop.
- (d) To what extent the quality and outturn of fibre are affected by different degrees of spacing.
- (e) Whether any improvement in the seed can be effected by giving the plants more space and thus ensuring a better growth than is given by the raiyats to plants from which they keep their seed.
- (f) Whether the retting process can be improved under such conditions as ordinarily prevail.

The same programme was carried out in 1904 as in 1902 and 1903 the programme for which the Department is indebted to the kindness of Mr. Mollison, Inspector-General of Agriculture in India. As in the previous years, the programme was carried out in its entirety only in the Burdwan experimental farm. As, however, Burdwan is really outside the jute tract, the

variety experiment was duplicated at three other centres in the heart of the jute area, *viz.*, as Jalpaiguri, Rangpur and Faridpur.

In the preceding years some of the races had apparently been spoilt by oversteeping. This naturally made it impossible to pronounce any opinion on their inherent merits. As the Burdwan farm hands were not accustomed to deal with many of them, at the suggestion of Major Prain some men were procured from Dacca and Mymensingh to guide the farms labourers during the entire season till the retting was finished.

In 1903 the different races were grown at Burdwan in two separate blocks. The two blocks had different cropping antecedents, and this made it impossible to compare the outturns. In 1904 therefore all the races were grown in one block to secure as far as possible a uniformity of soil conditions. But the land had a slight slope southwards. The evil effects of water-logging from which nearly the entire farm suffers in the rainy season were accentuated in the lower plots.

As the members of the Scientific Board desired to further investigate the question of cross-fertilisation of the races, the seed obtained from the farm crop of 1903 was sown in 1904. By their express wish no selection of the plants was made beyond ordinary thinning and weeding.

Soil is known to vary so much in the same farm and indeed in the same field that it often becomes very

difficult to interpret the results of comparative experiments. In 1903 when the different races were sown in two different blocks it was found difficult to compare them from the impossibility of eliminating the influence of soil variations. Though in 1904 we had all the races in one block yet, as has been mentioned above, the surface of this block was not even, there being a distinct slope southwards. In order to see how the soil varied at different parts of the field, a certain variety was, at the suggestion of Mr Burkhill, Economic Reporter to the Government of India, repeated at intervals, the variety chosen for this purpose being what is usually known as our farm-improved race. This idea was also followed at Faridpur, where the variety that was thus repeated at intervals went under the name of "deshi" or local jute. At Faridpur *chur* land was taken for the experiment. The land goes under water to a depth of several feet every year, but there is no water logging before the flood comes. There is a marked slope here also southwards.

The crop at Burdwan was manured with five tons of cowdung per acre ; that at Faridpur was not manured in 1904, though it had been manured with bone-meal in 1903, and there might be residues left. At Burdwan the different plots were harvested on different dates, as far as could be judged, at the same stage of maturity of the plants, e.g., as the pods set after flowering. At Faridpur, on the other hand, all the plots were harvested at the same time to prevent the crop from being swam-

ped by the flood. In each case all the varieties were sown on the same date.

The table given below would show that at, Burdwan the best plot (No. 10) gave exactly 50 per cent. more fibre than the worst plot (No. 30), though both were cut at the same stage of maturity. At Faridpur the difference between the best and the worst amounted to 57 per cent., though both were harvested on the same day. But besides soil variation there was unavoidable inequality of treatment of the different plots. The weeding and thinning were in some cases delayed by heavy rain falling in the midst of these operations. In the case of an extremely quick-growing plant like jute, even a very short interval in performing these operations would materially affect the vigour of the plants.

BURDWAN.				FARIDPUR			
Plot No. Farm seed.	Date of sowing	Date of harvest ing.	Outturn of fibre per acre	Plot No. Local seed.	Date of sowing	Date of har-vest- ing.	Outturn of fibre per acre.
10	18th May	12th Sept.	1,845 lbs.	3	13th Apr.	...	2,610 lbs.
13	Ditto	3rd do	1,665 ,,	12	Ditto	...	2,520 ,,
20	Ditto	Ditto	1,875 ,,	26	Ditto	..	2,025 ,,
30	Ditto	18th Aug.	1,230 ,,	30	Ditto	...	1,755 ,,
40	Ditto	29th do	1,500 ,,	34	Ditto	.	1,665 ,,
47	Ditto	27th Sept.	1,680 ,,	38	Ditto	...	1,710 ,,

The Burdwan figures in the foregoing table also show a connexion between the time of maturity for the sickle and the outturn of fibre of the same variety. Number 30, which gave the smallest outturn, was harvested first. Numbers 40, 13, 23 and 10 followed both in maturity and outturn in the order in which they are named. We come across a break in the chain when we come to the last harvested plot, *e.g.*, 47. On the whole we see to what an important extent outturn and maturity of the same race may vary.

But though the outturns of the same race or kind varied so much, the corresponding variation in the price per maund was not very great. Yet if we look more closely into the appraisement statement it will appear that this was not so much due to uniform quality as to some defects in one sample balancing (*so to speak*) other defects in other samples. In fact the only character that was fairly constant was the absence of "roots" as the lower portion of the fibre is called. The first harvested lot gave the best colour, but colour certainly did not go by the earliness of cutting. But it is most difficult to make out why No. 13 was so inferior to No. 20. Both of them were fairly well-grown crops and both were cut and washed on the same dates. Yet in every character (excepting roots) No. 13 was from 50 to 100 per cent, below No. 20. The difference in price between the two varieties was, however, not very great, being Rs. 8-3 against Rs. 8-12.

No. of plot.	Date of sowing.	Date of cutting.	Date of washing.	JUTE APPRAISER'S OPINION. (Full marks 16.)						Rs. A.
				Colour.	Strength.	Length.	Fineness.	Absence of roots.	Price per maund.	
10	May 18th	Sept. 12th	Sept. 26th	11	14	16	12	14	8 12	
13	Ditto	3rd	19th	8	8	12	6	14	8 3	
20	Ditto	Ditto	Ditto	12	14	14	12	14	8 12	
30	Ditto	Aug. 18th	Aug. 28th	13	14	8	12	14	8 10	
40	Ditto	29th	Sept. 14th	9	9	11	8	13	8 1	
47	Ditto	Sept. 27th	Oct. 15th	10	10	10	10	13	8	

There is a word or two to be said with special reference to the quality of strength. While appraising the samples of 1903 the jute experts took the strength of all of them as 16 annas as the samples were *dry* and had not been artificially watered. We interpreted this opinion as implying that slight differences in strength between one sample and another as there must be from the very nature of things did not matter practically. But the samples of 1904 were equally dry, yet they were pronounced as varying in strength from 7 annas to 16 annas.*

If then we have so much difference between plots

* It is perhaps due to irregularity in setting.—Author.

sown with the same seed and treated as far as possible alike, it becomes necessary to speak with much reserve when we come to different races and to the two species under which they fall.

Relation between earliness of maturity and outturn.

—At Burdwan the plots were harvested at four different periods, *e.g.* (1) 17th and 18th August, (2) 29th August to 3rd September, (3) 11th and 12th September and (4) 26th and 27th September. The following table gives the result :—

	lbs
(1) Average of nine plots— (30, 32, 33, 36, 57, 42—45)	... 1,312
(2) Average of 18 plots— (18—29, 34, 38—40, 46)	... 1,375
(3) Average of 11 plots— (1, 2, 4—12) ..	... 1,671
(4) Average of eight plots— (3, 14—17, 31, 41, 47)	... 1,694

Besides the above, one plot—that giving the highest outturn of any (Hewti White of Rangpur—2,110 lbs) was cut on the 23rd August. One or two of the plots (*e.g.*, 30 and 20) cut at the second period were as high in outturn as the average of those cut at the third period, and one or two plots (*e.g.*, 9 and 12) of the third period were as low as the average of the plants cut at the first period.

Relation between colour of the stems and colour of the fibre.—Numbers 6, 7, 14, 16, 21, 32, 34 and 37 had red stems. A reference to the appraisement statement would show that in five cases out of these eight the colour was no better than 8 annas, but on the other hand the colour of plots 34 and 37 was better than that

of most of the green races, being surpassed only by the Boran of Mymensingh, Bhadya White of Jalpaiguri and the farm-selected seed. (Compare also Nos. 32 and 33, 34 and 35, also 36 and 37.) But colour of the fibre seems to be a fickle quality. Taking an instance or two at random, we find Amonia of Faridpur (green stemmed which scored 14 points in 1903, scored no more than 8 in 1904 ; while Nalpat, also of Faridpur (red stemmed), which was awarded 8 points in 1904, get 12 in the previous year. On the whole perhaps green-stemmed plants are the best for colour.

C. olitorius species. — None were grown at Faridpur as being unsuitable for the low soil. Of the ten kinds grown at Burdwan Nos. 48—57), only three were pure green, the rest being red. Only one was early ; the remaining nine were late races — so late that when the *Capsularis* plants kept for seed in the adjoining plots were almost dead ripe with the pods dried black and the stems entirely denuded of leaves, the *Olitorius* races began only to flower. They all suffered severely from water logging even more than the adjoining *Capsularis* races. One curious thing was observed : in among the *Olitorius* plots there were a few stray *Capsularis* plants growing remarkably well and looking like giants among pygmies. It is not known to what particular race of *Capsularis* species they belonged, but they evidently had much power of resistance against the swampy condition of the fields. Should such plants re-appear in future the seed may be carefully kept as the starting-point of an important strain.

As the *Olitorius* races did not grow well, perhaps it would not be useful to examine them in much detail. The appraisement statement shows that they were, on the whole, superior to the *Capsularis* races in strength of fibre, but perhaps inferior in colour, length, and fineness. This inferiority is more markedly seen in the last line of the plots (Nos. 52-57) where the water-logging was the worst. Arrangements have been made for growing the *Olitorius* races on high ground in the present season (1905).

(e) *Manure experiment.*— The crop was sown on 10th May and harvested on 25th August, after exactly three and-a-half months. The following table gives the out-turn per acre and the financial result :—

Manure per acre.*	Outturn per acre.	COST PER ACRE.			Gross value of out-turn.	Profit or loss (net) per acre.	Rate per maund at Calcutta.
		For manure.	For cultivation.	Total.			
Mds.	lbs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs. A.
Cowdung... 75	1,985	4	78	82	214	132	8 10
Castor-cake 7	1,635	15	74	89	171	82	8 6
Bonemeal 10½	1,085	21	74	95	113	17	8 5
Ditto ... 5½	1,605	32	74	106	167	61	8 5
Saltpetre ... 4½							
No manure ...	1,230	...	72	72	129	57	8 6

*The manures were applied in quantities calculated on analysis to supply 30 lbs. of nitrogen per acre.

Cowdung again gave the highest outturn at the least cost as it did in the two preceding years. The bone-meal plot actually gave less than the unmanured plot. The Burdwan farm soil is deficient in phosphoric acid which is especially supplied by an application of bone-meal, and, generally speaking, crops respond very well indeed to this manure on the farm. But somehow or another it did not materially benefit jute. A mixture of saltpetre and bonemeal was more satisfactory, but the cost was much too heavy.

	outturn of fibre per acre.			
	1904.		1903.	
Cowdung	1,985	2,733
Castor-cake	1,635	2,506
Bonemeal	...	*	1,085	2,117
Bonemeal and saltpetre	...		1,605	2,238
No manure	1,230	2,022

The outturn it will be seen was poorer in 1904 than in 1903. But this held good not only for the manure experiment but for other experiments as well. The season at Burdwan in 1904 was not so favourable for jute as that in 1903. It may, however, be explained that while the land was allowed a rest during the *rabi* season before the jute crop in 1903, the jute crop in 1904 was preceded by a crop of wheat.

It is not always possible to write a manure prescription depending on the chemical analysis of a crop, but such an analysis is still of very great value in deciding the question of manuring.

It will be seen that the best-grown plants give the best quality of fibre also, *i.e.*, outturn and price go hand in hand.

(d) *To what extent the quality and outturn of fibre is affected by different degrees of spacing* : to this question it is difficult to give even any provisional answer yet. The crop was grown in four plots, and an attempt was made to keep the plants 4", 6", 8", and 10" apart from each other in the four plots, respectively, but the spacing could not even approximately be regulated, and what was worse, the plots were of very unequal quality. The 8" and 10" plots were particularly poor and patchy. The result, however, such as it was, is given below :—

Degree of spacing.	Outturn of fibre per acre.	Price per maund.	Date of cutting.	Date of washing.
• 4"	lbs.	Rs. A.		
4"	2,079	9 4	September 15th	rd October
6"	1,476	8 8	16th and 17th	9th ..
8"	882	7 14	19th and 20th	12th ..
10"	1,183	7 14	20th and 21st	13th ..

Taking the first two plots only, which alone were fairly comparable, an attempt was made in 1903 to ascertain approximately the actual spacing in these two plots, as also the number of plants and their green

weight at the time of harvesting. The following table gives the result :—

Supposed spacing.	Room allowed per plant (<i>i.e.</i>), average spacing.		Number of plants per acre.		Outturn of fibre per acre.	
	1903 Sq. in.	1904 Sq. in.	1903.	1904.	1903 lbs	1904. lbs.
4"	43	39	150,000	160,000	1,590	2,079
6"	65	63	100,000	92,000	1,050	1,476

It will be seen in both the years the real spacing was more like 6" and 8" than 4" and 6", respectively.

(e) The question *whether any improvement in the seed can be effected by giving the plants more space* and thus ensuring a better growth than is given by the raiyats to plants from which they keep their seed, does not admit of any definite answer yet one way or another. The thin sowing of seeds from thin plants of last year gave the best outturn ; but the converse did not hold good, namely, the thick sowing of seed from the thick plants of last year did not give the smallest outturn.

(f) Jute is such a bulky and heavy crop that, as Mr. Mollison has truly said, it is difficult to carry the bundles of green plants any distance, and the raiyats are obliged to use whatever water they find handy. Calculating on the basis that the fibre is 4.5 per cent. of the green weight, we see that 15 maunds of fibre per acre means a crop with a green weight of something

like 300 to 350 maunds. The conditions at Burdwan did not admit of retting the plants in running water, but the Rangpur and Dacca methods of washing the fibre were tried. The samples of fibre, however, washed in these two ways were declared by the jute experts to be identical in value so far as the market was concerned.

CHAPTER XXXVII

JUTE EXPERIMENTS IN BENGAL

(1905)

BY R. S. FINLOW, B. Sc.,

Jute Specialist Eastern Bengal and Assam

The production of jute in Bengal has, ever since exportation of the fibre commenced in 1828, expanded so rapidly and apparently with so little effort, that until quite recently little or no serious attention has been paid to its scientific development. During the last few years, however, Jute merchants have come to the conclusion that the quality of the fibre which is being produced is deteriorating, and in 1901 a request was made to the Bengal Agricultural Department to make the matter a subject for investigation. This has been done by carrying out Agricultural Experiments at Burdwan and elsewhere under the guidance of the Inspec-

tor-General of Agriculture. The objects of these experiments may be summarized as follows :—

- (a) To compare the respective fibres produced from different varieties of jute both as regards weight of outturn and quality of fibre,
- (b) to determine the stage of growth at which it is best to cut the plant,
- (c) improvement of varieties by selection,
- (d) manuring experiments,
- (e) relative merits of thick and thin sowing, and
- (f) retting.

As yet no very definite conclusions have been come to as to which variety or varieties are the best, and when this has been established for Burdwan, it will have to be proved to hold equally well for other districts before distributing the seed indiscriminately.

As regards the stage of growth at which the plant should be cut :—There seems little doubt that if cut when dead ripe, the yield of fibre is rather greater than if cut earlier ; but it also seems equally certain that the quality of the fibre from the late cut plant is not so good as that obtained from the plant cut at an earlier stage. These experiments are being continued, and it is hoped that it may be possible, in future, to supplement the results by subjecting the samples of fibre produced to chemical and other tests in the laboratory.

The manuring experiments tend to show the superiority of cowdung and castor cake over other fertilizers. Cowdung is the best and cheapest manure when it can

be obtained, but castor cake and even a mixture of bone-meal and saltpetre appear to justify their application by yielding an increased net profit. These experiments will doubtless be continued, as the results, if borne out by others, are important. There is much land in the jute districts, especially in places which receive no annual deposit of silt, which respond readily to manure, as one can see at a glance by comparing the crops near the homestead with those a little distance away. The advantage is very much with the former, doubtless on account of the extra manure they receive. If this state of things is to be changed, the raiyat will have to be taught to supplement his scanty supply of cowdung, with manures like castor and other cakes which often give results out of all proportion to their present cost.

As regards the improvement of varieties by selection, the Bengal Agricultural Department has this year taken over plots of land in Faridpur, Mymensingh and Rangpur on which typical varieties of jute for ¹ and otherwise, are being cultivated for seed alone. It is hoped that by encouraging a vigorous growth of the plants, by allowing them plenty of room, and by sacrificing the fibre for the sake of the seed, an improved strain of plant will be the result. If this scheme proves successful on the small scale, the plots are about 20 acres in extent, it is proposed to start a system of distribution of seed, obtained in this way, on a large scale.

Retting—Under this heading may be included all

the operations which the plant undergoes during the separation of the fibre from the rest of the plant.

After the plants have been cut they are tied up into bundles and immersed in water, where they are allowed to remain until the fibre comes away quite easily from the woody portion of the stem. This is brought about by a fermentation during which the tissue in which the fibres are imbedded is softened or dissolved. It is, apparently, the result of the work of a particular bacterial organism, and sterilized stems of jute inoculated with what are believed to be pure cultures of this organism ret rapidly. A most interesting observation has been made, viz., that if small amounts of Ammonia salts and salts of Phosphoric Acid be added to the water in which the retting takes place, the fermentation proceeds far more rapidly than in pure water. This may prove to be of value commercially. There can be little doubt that a prolonged immersion in water weakens the jute fibre. If therefore the time of retting could be materially shortened, a superior fibre would presumably be the result. It is impossible, however, to say anything definite until experiments have been conducted on a larger scale than is possible in the laboratory.

In the course of the investigation into the retting of jute it was discovered that various moulds, when allowed to grow upon the stems, kept in a moist condition, have the power of dissolving or softening the tissue in which the fibres are imbedded : in other words, of performing the retting process. This is no doubt the rationale of "dew retting" of flax in Europe ; but with

regard to jute, it is of Scientific, rather than Economic, interest.

It is most essential for the production of fibre of good colour that the retting water be clean, *i.e.*, free not only from much suspended earth, but free as possible also from traces of iron in solution. If the water is muddy, the fibre loses its lustre and becomes greyish in colour, and experiments have proved that a brown fibre results from retting in water containing iron. Unfortunately the raiyat cannot always choose his water for retting. A good crop of jute, when green, weighs between 300 and 400 maunds per acre, and it would not pay him to cart such a weight far, even if suitable water were available at a distance. It ought always to be possible, however, to wash the separated fibre in clean water.

Deterioration.—The possible causes of the deterioration which, it is generally admitted, has taken place of late years in the quality of jute fibre may be enumerated thus :—

- (1) The plants grown for the sake of the fibre have actually degenerated.
- (2) Lands not suited to the growth of jute have been planted with it; thus producing inferior fibre.
- (3) Kinds of jute are cultivated which are unsuitable for the particular locality in which they are grown.
- (4) Lands growing jute are becoming exhausted owing to insufficient manuring and lack

of application of the principle of rotation of crops.

(5) Retting is not now performed with the same care as formerly.

(6) The deterioration is due to the practice of fraudulent watering of the fibre to increase its weight before bringing it into the market.

(1) The Sub-Committee of the Board of Scientific Advice pronounce unhesitatingly against the idea of degeneration in the jute plants. They say : "The best kinds now as then if cultivated, liberally yield excellent crops and their fibre, if properly extracted, is also excellent."

The second, third and fourth causes undoubtedly account for the appearance in the market of fibre of inferior length and fineness.

The experiments at Burdwan, Faridpur, Mymensingh and Rangpur mentioned above deal with these questions and are to be looked to for a remedy.

(5) Carelessness in separating and washing the fibre after retting is complete is the cause of sticky, dirty fibre. In isolated cases the raiyat, having more than he can do properly, may not clean his fibre properly ; but this is by no means generally the case.

(6) One of the principal causes of the deterioration of jute fibre is undoubtedly the practice of adding water and sometimes sand, to the fibre to increase its weight before bringing it into the market.

The practice of fraudulent watering only commenced a comparatively short time ago ; but it is now almost

universal. Accurate estimations have been made of the amount of water, in a number

*The sample was dried at 100°c. of samples of watered jute. The percentages of water, calculated

on the wet sample,* varied from 21 per cent to over 55 per cent. On the other hand, estimations have been made of the amount of moisture taken up by jute fibre from a saturated atmosphere at about the temperature of the rainy season. The results which are fairly consistent place the maximum of hygroscopic moisture below 20 per cent under the most favourable conditions.

The balers have to dry the wet jute in the sun before baling it, for jute is a fibre which is exceedingly sensitive to the action of water, and if it is baled or even rolled into "drums" in the wet condition it soon begins to heat, after which rotting of the fibre takes place in an astonishingly short time.

There is a very strong probability that of recent years a good deal of fibre which has been wetted has been baled for export before being properly dried. There is little doubt that such fibre would be quite rotten and therefore useless from a spinning point of view when it reaches its destination. It is easy to see from this how impressions have got abroad concerning the deterioration of the jute plant, whereas all the deterioration has really taken place after the fibre has left the hands of the cultivators.

Extension of the area under jute cultivation.—According to the annual returns, the area under jute cultivation and the weight of fibre produced are continually

expanding. Nevertheless the demand continues equal to the supply.

In view of the fact that more and more persistent efforts are being made to grow jute in other countries, e.g., in Java, French Indo-China and west Africa, where £ 3,000 is said to have been spent last year on experiments, it is advisable to consider whether the area of cultivation cannot be extended from Bengal to Madras, Bombay and Burma, in each of which Provinces it has been suggested there are tracts suitable for the purpose.

CHAPTER XXXVIII

FRAUDULENT WATERING OF JUTE

BY D. N. MUKERJI M. R. A. C.

Assistant Director of Agriculture, Bengal

(1) Early in November last I visited Sirajganj in district Pabna, and later in the same month I visited Chandpur in district Tippera. My object was twofold : (1) to obtain evidence of the alleged practice of watering jute ; and (2) to ascertain, if possible, the extent of the evil.

(2). At Sirajganj not only water, but also sand is added to jute to fraudulently increase its weight. The practice is perfectly notorious: the whole population testifying to its prevalence. The dealers are said to sand and water their jute quite openly in broad daylight and close to the mart. Mr. How, of the firm of Messrs. Landale and Clark, said he had seen it being done hundreds of times. Mr. Murat said he had seen it time after time almost everywhere between Berra (district Pabna) on the one side, and Sarsibari and Panibari district Mymensingh) on the other. He estimates that quite 75 per cent. of the jute at Sirajganj is watered, or both watered and sanded. The dealers take the jute out of the boats spread it out on the banks of the river, layer after layer, and sprinkle sand and water on each layer as it is spread out. Then the jute is re-drummed and put in the boats again for sale, a few fairly dry drums being put in front. I did not see any watering being done, but Mr. Murat kindly took me nearly over the entire mart and helped me in examining the cargo of some sixty boats at random out of the several thousands there were at the *ghat*: it is no exaggeration to say that I found the jute in at least fifty of the boats examined more or less wet, and many almost dripping wet. But I noticed no sand, and understood that no sanding had yet been practised this year. In the other jute marts there is no sanding, but watering is very bad at Chandpur, and is said to be worse at Jagannathganj (district Mymensingh) and Madaripur (district Faridpur). On the other hand, I understand, at Narayanganj

(district Dacca) the evil is not so serious. On the whole, northern jute, *i.e.*, from Rangpur, Jalpaiguri, Cooch Behar and Assam is more dry than that from other places. At the time of my visit northern jute was selling for Rs. 5-2-3 against Rs. 5 for Mymensingh jute, the average of the market being no higher than Rs. 4-4.

(3). It is only in a high and rising market that jute is adulterated most, *i.e.*, when the supply is short, and the dealers know that the purchasers will be obliged to buy it wet or dry. Under the present system of contract sales a certain quantity must be delivered at the mills within a prescribed time. Competition is so keen that a combination of the buyers to put down watering is quite hopeless. Formerly, under the old system of commission sales, the mufassal price used always to be much lower than the Calcutta price, so that people used to send down jute to Calcutta in boats. But this chalan work is now completely gone, as the mufassal price is so high- often higher than the Calcutta price. At the time of my visit the price was 8 annas per maund actually higher at Sirajganj than at Calcutta. It appears the evil has assumed serious proportions only since 1891 (*i.e.*, 1298 B.S.) when the fibre sold at Rs. 9 per maund and when one Choke Chand Marwari began the sanding and watering on an extensive scale at Sirajganj. Jute treated in this fashion has come to be known after him as "Choke Chandi."

(4). The fine particles of sand stick to the fibre so long as it continues wet but can be easily shaken off

when it gets dry. But the watering is a very much more serious thing. If wet jute is baled or stacked for a few days, the fibre loses its lustre and becomes discoloured and weak—sometimes so weak and brittle that it may be reduced to a fine *powder* by merely pressing it between the thumb and the finger. It is of course not necessary to add that in this condition it wholly ceases to have any value at all as a fibre.

(5. Some firms dry the jute before baling, but others are perfectly reckless about what they bale. Large firms have arrangements for the examination of every drum that is purchased and for drying it properly if found wet before baling it. The firms have to keep up quite an army of assorters for this purpose, who are scattered all over the mart, a length of over two miles. It would be very convenient if the *mahajans* allowed the jute boats to come to the *ghat* close to the European firms ; but though the Bengali *mahajans* are agreeable, the Marwaris refuse to give in. The consequence is that it becomes practically impossible to properly supervise the work of the assorters. They are men on a small pay, and are constantly passing wet jute as dry, on receiving a small bribe from the *heparis* (*farias* ?) Thus in spite of strenuous efforts, several of the most respectable firms are powerless entirely to prevent the baling of wet jute. But there are other firms that make no bones of the superfluous moisture. They send the jute over to their godowns in Calcutta, where it is sold to the mills or to the shippers. The examination of the jute by the buyers in Calcutta is not so thorough as at

Sirajganj, and various means are resorted to for avoiding the detection of any excess of water.

Between the raiyats at one end and the home market at the other there are the following middlemen : *beparis* or dealers, *mahajans* or *araldars*, buyers, balers, and shippers. Sometimes the last three functions are combined by the same firm that bale and ship off at Calcutta what their agents buy in the country. But the business at Sirajganj may be said to be practically in the hands of the *mahajans* or brokers. They are well-to-do people, being mostly Marwaris. They advance money to the *beparis* or sellers, the condition being that the latter must bring to the *mahajans* all the jute they can get from the raiyats. The money is not realised from season to season, but is allowed to be in the hands of the *beparis*, one *bepari* sometimes having an advance of Rs. 5,000 or Rs. 10,000 and occasionally no less than Rs. 20,000. When the jute is brought to the *mahajan*, he settles the price with the buyer secretly, the *bepari* having nothing to do with it and often not knowing at all what his jute sells for. He has only a general idea of the state of the market from the price other *beparis* receive for their jute. I witnessed, on several occasions, the way the price is settled between the *mahajan* and the buyer. The *mahajan* throws a corner of his *dhuti* over the hand of Mr. X and makes a sign on his palm. The latter exclaims in surprise it is far too high and he cannot possibly pay more than so much, making an answering sign on the palm of the *mahajan* still under

the *dhuti*. After some haggling, the negotiation terminates. The *mahajan* now at once settles with the *bepari*, who goes home with his money, he (the *mahajan*) being paid by the buyer a few weeks (generally three weeks) latter. The *mahajan* gets a brokerage of 2 to 4 annas per maund, but over and above this we may be sure he leaves a margin between what he pays the *bepari* and what he himself gets from the buyers. Plainly he is entitled to some discount for the ready cash he pays in advance, but the rate might be definitely settled, and the transaction might be above board. The price of jute is subject to violent fluctuations. Probably there is no other article the price of which varies so much in the course of a few days in the same season. Both the buyers and the *mahajans* have daily wires from all the important jute marts telling them of the state of the market, but the information is carefully kept to themselves. It might be an advantage to have some agency for making it public. At Chandpur there are no *mahajans*, but the *beparis* deal directly with the buyers. The raiyats also to some extent sell their own jute to the purchasing firms without the intervention even of the *beparis*.

6. Mr. Manuk, the Manager of the Chittagong Company, Babu Sarat Chunder Shome, of Messrs. K. M. Dey and Company at Chandpur, and many others who have had extensive dealings both with the *beparis* and also directly with the raiyats are clearly of opinion that the latter never water their jute and generally dry it thoroughly. It is the *beparis* who buy it of the

raiayats, water it heavily and sell it at a lower price per maund than they bought it. Yet they manage to make a good profit, *i.e.*, comparatively speaking the price of wet jute is higher than that of dry jute. At Sirajganj, also, the heads of several important firms expressed the opinion that the raiyats might not always dry their jute properly, but they were seldom guilty of deliberate watering; that was the work of the *beparis*.

7. Even what is generally held in the trade as dry jute is not as dry as it might be, is not "bone dry" as it is called. If such jute is exposed to the sun, it quickly loses 8 to 10 per cent. of its weight. This amount (which of course represents moisture) does not affect the quality of the fibre in the bale or in the stack. The mills also accept this amount of moisture (10 per cent. up to November and 1 December and 8 per cent. later), but any quantity above this is held as objectionable. The mills now generally insert a clause in their contracts to the effect that deductions will be made for moisture in excess of the aforesaid quantities. It is, I understand, not at all uncommon to deduct as much as 12 per cent. on the weight delivered of Madaripur jute. Some of the mills have their own agents at Sirajganj, Chandpur, etc. Such agents do not object to buy wet jute, as it need not be baled or stacked, but used in the mills as soon as it arrives.

I obtained two samples of well-dried jute from the godown of Messrs. David and Company of Sirajganj on 8th November. I also obtained a sample of well-

dried Chandpur jute from the godown of the Chittagong Company on the 25th. In each case 2 lbs. weight of the fibre was dried in the sun for two days and then reweighed with the following result:—

Name of sample	Original weight.	Weight after two days' drying in the sun.			Percentage of loss (moisture on drying.)
		lbs.	oz.	dr.	
(1) Fine Mymensingh	2 0 0	1	12	7	9.10
(2) Fine Bilasipara (Assam)	0 0	1	12	7½	9.57
(3) Chandpur	0 0				8.98
Average...					9.45

8. I similarly obtained two samples of wet jute from two *bpearis*' boats at the Sirajganj ghat on the 8th November. The samples were chosen for me by the jute purchaser of Messrs. David and Company, a Bengali gentleman of some 30 years' experience. A third sample of wet jute was chosen for me by Mr. Murat on the following day (9th Novemeer). The fourth sample mentioned below was obtained from a boat at the Chandpur ghat by Mr. Manuk on 25th November. Like the samples of dry jute, these were

also exposed to the sun for two days and then reweighed with the following results:—

Name of sample	Original weight.	Weight after two days' drying in the sun.			Percentage loss on drying (moisture)
		lbs.	oz.	dr.	
(1) { a b	2 0 0	1	8	2½	24.22
	2 0 0	1	8	1½	
(2) { a b	2 0 0	1	8	6	22.95
	2 0 0	1	8	4½	
(3) { a b	2 0 0	1	8	4½	21.97
	2 0 0	1	9	3	
(4)	2 0 0		9	0	21.88
Average					22.75

In both the above series the dry weight was taken about 3-30 P.M. As will be seen later on, all these samples reabsorbed some two per cent. of moisture by the next morning and one or two per cent. more by being stowed away for a few weeks from atmospheric humidity.

9. The third sample in the wet series was examined at short intervals to see how quickly the moisture left the fibre. It was weighed out about 2 P.M. into two parcels of 2 lbs. each. Both the parcels were reweighed

at 3-30 P.M. and again at 4-30 P.M. with the following result :—

Taking the average of the two samples, it will be seen the loss of weight at the end of $2\frac{1}{2}$ hours amounted respectively to 16.89 per cent and 19.14 per cent. Seeing that the sample contained no less than 21.97 per cent. of moisture and that out of this as much as 10 per cent. was acceptable to the mills and balers, an hour's drying would probably have quite sufficed to make it unexceptionable. In other words, jute parts with moisture so quickly that the plea of difficulty in drying to explain the presence of too much water can never stand.

10. * The three samples of dry jute mentioned in paragraph 7 were stored away in a dry but shady place for a few weeks after which they were examined with the following results :—

Name of samples.	17th December, 10 A.M.	17th De- cember, 2 P.M. after 4 hours drying)	18th De- cember, 8 A.M.	23rd De- cember, 8 A.M.
	lbs. oz. dr.	lbs. oz. dr.	lbs. oz. dr.	lbs. oz. dr.
(1) Dry Mymensingh	1 14 1	1 13 2	11 4 1	1 14 1
(2) Do. Bilasipara ...	1 14 1	1 13 1	11 4 0	1 14 1½
(3) Do. Chandpur ...	1 14 5	1 13 5½	11 4 2	.....
Wet do.	1 10 2	1 9 4	11 0 8	1 10 3

It will be seen that none of the samples returned to their original weight by reabsorption of moisture after they had once been thoroughly dried in the sun. The "bone dry" fibre does gain a little (between 3 to 4 per cent.) in weight with the fall of temperature and a consequent rise in the humidity of the atmosphere, but not more, however long the fibre may stand. The permanent loss in weight by bone drying in the case of the dry samples was about 6 per cent. and in the case of the badly watered samples as much as 18 to 20 per cent.

11. Nor is it any excuse to say that jute gets damp by exposure to night dew. I made three experiments with bone-dry jute by (1) spreading out two samples to the dew at night, (2) by leaving by their side two other samples in bundles exposed to the dew, and (3) by leaving yet two other samples in bundles under a thatch. A fourth sample was kept inside a room. The following results were obtained in the morning :—

Nature of treatment	Gain in weight by absorption of moisture.	Per cent.
(1) Opened out to night dew	... 18.52	.
(2) Left in bundles exposed to dew	.. 6.40	
(3) Ditto under a thatch	... 2.93	
(4) Ditto inside a room	... 2.42	

The figure in the second case would be, I believe, much less if the fibre was stacked in large heaps. But the third experiment shows that a simple thatch would

be a very good protection and keep the jute thoroughly dry. Jute therefore cannot only be very easily dried, but can also be as simply kept dry. Excessive moisture almost in every case points to deliberate fraud.

12. A sample of dry Mymensingh jute that had already lost 5·85 per cent. was handed to Professor P. C. Roy, D.Sc., of the Presidency College, on 18th December for determination of the absolute moisture in it. After drying in a steam chamber, he found it lost 8 14 per cent of its weight. So this sample, as it was obtained from the godown of Messrs. David and Company, contained almost exactly 14 per cent. of moisture. On the other hand, the absolute quantity of moisture in a bad sample of fraudulently watered jute like sample in paragraph 8 seems to be no less than 28 or 29 per cent. The absolute quantity of moisture in any sample of jute, however, is not a thing of much practical value, as the arrangements and apparatus, as also the skill required for its determination are not at the command of practical men. But the relative amounts of moisture in a well-dried and a fraudulently-watered sample may be always ascertained very easily by almost anybody.

13. Summary—

(a) There is abundant evidence that jute is fraudulently watered by the *beharis* or dealers who buy it of the cultivators and bring it to the marts, *e.g.*, Serajganj, Chandpur, etc. At Serajganj the jute is often further adulterated with sand. These

adulterations are practised quite openly now.

- (b) The raiyats generally dry their jute thoroughly and are not guilty of any fraud.
- (c) The so-called dry jute of commerce often contains 8 to 10 per cent. of moisture. This amount of moisture is accepted by the mills. Its presence does not affect the quality of the fibre. This is the amount that may be got rid of by drying in the sun.
- (d) In bad cases of watering the moisture goes up to 20 or 25 per cent.
- (e) Wet jute, if stacked or baled, gets discoloured and weak. In bad cases it becomes absolutely brittle and powdery retaining no value whatever as a fibre. The fraudulent watering of jute by the *beparis* appears to be the chief cause of the deterioration of which the merchants complain.
- (f) Wet jute can be very easily dried in the sun, and dry jute can be as easily protected from dew by simply bundling or drumming it up. Dry jute, if left under a thatch, absorbs very little moisture from the humidity of the night air.

CHAPTER XXXIX

JUTE IN ROTATION WITH PADDY

By F. SMITH, B. Sc.,

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At Burdwan this experiment was commenced in 1905 when a crop of jute was obtained from the same land in the one year. After harvesting the jute crop towards the end of July, *aman* paddy was transplanted and the crop was harvested at the same time as the ordinary paddy crop in the beginning of December.

In 1906 the experiment of growing paddy in rotation with jute in the same year was repeated. Jute was sown in the second week of May and the crop was harvested in the first week of August. *Aman* paddy was transplanted in the third week of August and the crop was harvested in the first week of December. The land received the following treatment for the preparation of the jute seed bed :—

- 8 ploughings,
- 3 ladderings,

and the jute crop was *bidared* three times, thinned once and weeded twice; while after the jute crop was harvested, the land was ploughed three times and ladderied once to prepare for the transplanting of *aman* paddy. The paddy crop was given one weeding, one hoeing and one watering. The following table shows

the result of the experiment during the past two years :—

CROP.	Quantity of manure applied per acre.	Date of planting.	Date of harvesting.	OUTTURN PER ACRE	
				Grain.	Straw or fibre.
1905				Mds.	Mds.
Jute ..	Cowdung, 5 tons	1st May.	20th July	...	16
Paddy (coarse) ..	No manure ..	3rd Aug.	4th Dec.	15 $\frac{1}{2}$	19 $\frac{1}{2}$
1906				Mds.	Mds.
Jute ..	Unmanured	10th May	3rd Aug.	...	17 $\frac{1}{2}$
Paddy (coarse) ..	Salt petre, 30 seers	18th Aug.	5th Dec.	18	22
Jute ..	Unmanured	10th May	3rd Aug.	...	17 $\frac{1}{2}$
Paddy (fine) ..	Salt petre, 30 seers	18th Aug.	5th Dec.	12 $\frac{1}{2}$	19

In 1905 meteorological conditions were not favourable to a good paddy crop. In July the abnormal amount of 37.95 inches of rain was recorded, in contrast to an average of 12.32 inches for the district, while 3 inches more than the normal rainfall was recorded in August and September. This caused very unfavourable growing conditions for the paddy crop before September. A yield of 16 maunds of jute followed by an outturn of 15 $\frac{1}{2}$ maunds of paddy grain and 19 $\frac{1}{2}$ maunds of straw is, therefore, very reassuring.

In 1906 no rain fell in April, and as the canal was unable to supply water, the jute sowing was three weeks late. Hence the jute harvest was restarted and the growing period of the paddy crop was shortened by three weeks. The return of 17 $\frac{1}{2}$ maunds of jute followed by 18 maunds of grain plus 22 maunds of straw from a coarse variety of paddy and 12 $\frac{1}{2}$ maunds of grain

plus 19 maunds of straw from a fine variety of paddy, are very satisfactory.

1905.—In this year, $\frac{1}{10}$ acre plots were taken. These plots had for the previous five years only grown jute each year. Cowdung at the rate of 5 tons per acre was applied to the land before the last ploughing in the preparation of the jute seed bed, and the paddy crop received no manure.

1906.—This year four $\frac{1}{9}$ acre plots were taken on land that had previously grown sugarcane. No manure was applied to the land for the jute crop, but the paddy crop was top-dressed with thirty seers of saltpetre per acre.

The following statement shows the economic result of the experiment in 1906 :—

CROP.	YIELD PER ACRE.		Cost of cultivation, per acre.	Money value of outturn, per acre.	PROFIT. Per acre.
	Grain.	Fibre or straw.			
•	Mds.	Mds.	Rs. A.	Rs. A.	Rs. A.
Jute ... .	... .	17 $\frac{2}{3}$	52 6	179 7	127 1
Coarse paddy ...	• 18	22	35 1	57 3	22 2
				Total per acre.	149 3
Jute ... ...	... ...	17 $\frac{2}{3}$	56 13	180 12	123 15
Fine paddy ...	12 $\frac{2}{3}$	19	36 0	64 13	28 13
				Total ...	152 12

These figures do away entirely with the idea that if the area of jute cultivation is increased, the people's food-supply will be imperilled, for not only is the raiyat's food-supply assured by the paddy crop, but in the same year a crop of jute is obtained from the same land, and this extra crop will enable the cultivator to obtain other necessities of life than those ensured by the paddy crop. A net profit of Rs. 150 per acre is well worthy of a farmer's consideration.

CHAPTER XL

THE JUTE CROP OF INDIA

By N. N. BANERJEE, B.A., M.R.A.C.,

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THE modern jute industry of Bengal may be said to have had its origin in the year 1828, when exportation to Europe commenced. Before this time considerable quantities of the fibre were undoubtedly produced, but the entire output was consumed locally. A footing having been once established in the European market the value of the fibre was immediately recognized, and the expansion of the trade, has ever since, been constant and rapid.

In a recent article which appeared in the *Times* of London, jute was described as one of the great assets of the Empire, and most certainly it is a most valuable asset for it brings money to our Indian cultivators, to

numerous Indian and European dealers, to merchants and ship owners, and to a host of manufacturers both in Calcutta and Dundee. The demand for jute, in spite of the remarkable expansion in its cultivation in recent years and the rise of prices to an unprecedented height, still continues to be very keen, and consumption, at the present day is very near to outstripping production. Not only are old markets asking for increased supplies, but new ones are continually opening out. And jute fibre is further being put to an increasing number of uses every year.

The importance of jute in the sphere of commerce may be gauged from trade reports, which reveal the fact that the exports of raw and manufactured jute constitute one-fifth of India's total exports. Taking the two Provinces of Bengal and Eastern Bengal and Assam, from where practically all the jute of India comes, it may be noted that the outturn has risen steadily from $65\frac{1}{2}$ lakhs of bales of 400 lbs. each) in 1900 *i.e.*, about 325 lakhs of maunds, to over 85 lakhs of bales *i.e.*, about 425 lakhs of maunds - the estimated outturn of the crop for the present year (1906). The total consumption which includes exports, mill-consumption and country consumption, has also similarly risen from 65 lakhs of maunds in 1900 to 81 lakhs in 1905. The consumption this year, will no doubt show a further increase. Side by side, with an increase in production the jute industry itself has developed enormously in this country ; the number of looms at work having increased from 9,841 in 1896 to 23,884 in 1906, and the actual

consumption of jute by the mills has doubled during the last ten years.

To pass on to the financial aspect of the jute trade, I do not think that I would be wrong in stating that prices also have doubled during the last ten years. During 1905-06, the average price per bale of 400 lbs. was Rs. 46 and no less a rate than Rs. 70 per bale is also reported to have been paid by purchasers during that year. What is believed to be the highest price on record is the phenomenal price of Rs. 85 per bale which was recently paid for a small parcel of Dacca jute of quite exceptional quality. The transactions of the jute market this year may be expected to disclose that about 37 crores of rupees are likely to change hands, as a result of the general cultivation of the jute crop in Bengal and Eastern Bengal and Assam and of its very limited cultivation in Cooch Bihar, Nepal, Madras, and Upper India.

It has been estimated, that jute agriculture brings in over 21 crores of rupees to the growers, and it may bring in as many crores more in another ten or twenty years, if there is the same expansion in its cultivation as there has been during the last decade. The increased payments to cultivators of jute, caused by the rise in price during recent years has amounted to several crores of rupees. They are making very large profits over the crop, and all Bengal *raiayats*, whether jute growers or cultivators of other crops, cannot therefore but be deeply concerned in its improved cultivation.

There is still ample room for the extension of its

cultivation and there is decidedly a necessity for improving its quality. Complaints have been frequent of late regarding the deterioration of jute fibre, and it is for the cultivator to rise to the occasion and to remove this defect. Otherwise, the industry is likely to suffer in the near future. If the manufacturers of Europe and America do not get better stuff than what is being sent to them at present, they will surely turn their eyes to other markets than ours.

At present, the seller seems to be quite certain of a market for his fibre, even though it is of inferior quality and adulterated, but he should open his eyes to the fact that in Java, French Indo-China and West Africa, continuous and in some cases successful efforts are being made to introduce the cultivation of jute. Of course another solution of the dilemma presents itself in adopting other possible substitutes for jute such as *san hemp* (*Crotolarea juncea*), *patua* (*Hibiscus cannabinus*), *Dha-inche* (*Sesbania aculeata*), American aloe (*Agave Americana*), *Murvi* (*Sansevieria Zeylanica*) *Akanda* (*Calatropis gigantea*), *Ramie* or *Rhea* (*Bohemia nivea*), *Flax* (*Linum ussitalissum*),—but more is known of the capabilities of jute than of any of the other fibres. Therefore at the present time the cultivator may well be exhorted to look to his jute and jute alone.

There are various causes which lead to the degeneration of jute, such for example as the actual degeneration of the plants grown for fibre, the growth of the crop on unsuitable soils, the use of inferior seed, the cultivation of varieties of jute, which are unsuitable for the particu-

lat locality in which they are grown, the want of proper cultivation and of judicious manuring, carelessness in the preparation of fibre for the market and last but not least the fraudulent adulteration of the produce in order to increase its weight before bringing it into the market—a notorious and wide-spread malpractice, which is bringing a valuable staple into disrepute in foreign markets, and is damaging the common interests of the trade.

Fraudulent Adulteration.—Cultivators, sellers and purchasers of jute are earnestly exhorted in their own interests, to refrain from adulterating their jute with sand and water. This practice has led to a most unwarantable deterioration of the fibre in recent years; and merchants are loud in their complaints regarding the quality of the fibre now being put into the market. In September 1901, the Calcutta Baled Jute Association addressed the Director of Agriculture, Bengal, on the subject of the deterioration of the quality of the fibre. This was followed in January 1902 by a communication to the same effect from the Dundee Jute Inspectors' Association to the Secretary of State for India. As a result, field experiments were started at the Burdwan Experiment Station in 1902, by the Bengal Agricultural Department under the guidance of the Inspector General of Agriculture, India. These experiments continue, and have up to this disclosed very instructive results but still there exists fraudulent adulteration which impedes the efforts of the Agricultural Department in the matter of improvement of the fibre—repressive Legislation may

be sought for, but unless the gravity of the situation is taken in by growers, sellers and purchasers, the quality of the fibre will stand where it is at present and in fact will become worse day by day and year by year. Soon after the commencement of field enquiry into the causes which tend to a deterioration of the crop, it was recognized by Government, that it was necessary to supplement and amplify field work by laboratory experiments. This work, dealing more with the chemical and biological side of question was entrusted to an expert officer in the person of Mr. R. S. Finlow.

PART V—MISCELLANEOUS

CHAPTER XLI

SUBSTITUTES FOR JUTE

Hibiscus cannabinus and *Crotalaria juncea* are the only two fibrous crops in India which may be mentioned as the possible substitutes for jute. Brief accounts of these two crops are given below by way of comparing them with jute.

HIBISCUS CANNABINUS

(Mestha pat)

It is called *Mestha pat* in Bengal, *Patua* or *Kudrum* in Bihar and Chota Nagpur, *Bimlipatam* jute or *Bombay hemp* or *Amburi* in Bombay and *Gogunara* in Madras.

The *Mestha pat* is the most accommodating fibrous crop known. It is grown on all kinds of soils and lands—alluvial or laterite, high or low. Some years ago, it was largely cultivated in Eastern Bengal, but of late, jute has completely taken its place. There is still a limited cultivation of this crop on the *bheel* lands which are considered too low to be suitable for jute.

On the *bheel* lands it is sown in February and March, and harvested in July and August. In Bihar and Chota Nagpur it is generally sown in June and July, and harvested in September and October. It

thrives pretty well in other seasons if the soil has sufficient moisture. Thirty seers of seed are ordinarily required for sowing one acre of land, if it is sown by itself. *Mestha* is commonly sown as a mixed crop with paddy in East Bengal and with sugar-cane or *rahar* and cotton or on the borders of fields in Bihar. The quantity of the seed is, of course, to be lessened if it is sown as a mixed crop. The plants are so thinned as to allow a space of 9 inches around each plant. The flowering stage is considered the best time for harvesting. It requires about three months from the time of sowing to the time of cutting. In East Bengal the plants are pulled up and steeped as jute. In Bengal the method of extracting fibre is the same as that of jute. In Bihar and Chota Nagpur, the bundles of plants when they are ready for stripping are taken away and dried; afterwards the fibres are separated from the piths or stalks. Fifteen maunds of fibre per acre are considered a good yield in East Bengal and ten maunds in Bihar and Chota Nagpur, if the crop is sown by itself.

The fibre of *Mestha* is bright and glossy, and a little stronger than jute, but coarse and harsh. On the whole it is inferior to jute. *Mestha pat* is commonly used in cordage and sacking.

CROTOLARIA JUNCEA
(*San hemp*)

There are two varieties of San hemp in Bengal; one of them which is called *ful* or *bhadoi* San is

sown in June and harvested in October and November and the other variety called *gour San* or *rabi San* is sown in October and November and harvested in February and March. The quality of the fibre of the *rabi San* is superior to that of the *bhadoi San*.

It is stated by Mr. R. S. Finlow the Jute Specialist to the Government of Eastern Bengal and Assam in the Bulletin on "the Extension of Jute Cultivation in India" that "the extent of the cultivation in Madras for fodder purposes may be gauged from the fact that of the 205,000 acres returned as being under sunn hemp this year (1900), much the greater portion of the crop will be used as fodder". *San* is never cultivated in Bengal as a fodder crop. It is grown to a very limited extent in some quarters in East Bengal as a green manure.

It thrives on all kinds of soils provided the lands are well drained and above the inundation level.

The seed is sown broadcast thickly—2 maunds being required for one acre of land. The sowing must be very thick otherwise the plants will grow bushy causing the extraction of fibre extremely difficult. The *rabi* variety may be grown in rotation with jute or *aus* paddy in the same year. This variety cannot be grown in Chota Nagpur and Bihar for want of steeping water.

The plants are either pulled up or cut to the ground. The best fibre is obtained when it is harvested at the flowering stage. Generally the crop is harvested when the seeds ripen in order to get a heavier yield and also the seed.

In East Bengal, after the plants are cut or pulled up, they are spread over the fields for withering. On the second day the plants are tied in bundles and submerged under water, applying some artificial weight (commonly sods of earth) over them. There is another process for steeping in which the bundles are placed up-right in water about 2 to 3 feet deep for one day, submerging them completely on the next day. Retting generally finishes by the fifth day. The plants are stripped immediately after retting is complete or else the fibre will be totally lost. It is stripped in the same way as jute in Orissa. The great obstruction in the way of its extended cultivation is the difficulty in stripping. The yield of fibre is from 9 to 12 maunds per acre.

The *San* fibre is decidedly stronger than jute, specially when wet, but the yield is much less, while the cost for stripping is much more. In India the fibre is very largely used for making fishing nets, but to a limited extent, for weaving rugs. Excepting *Rhea* (*Kunkura*) there is no other fibre in India which can replace *San* in the use of fishing nets. Wet or damp jute rots quickly, and therefore, it is useless for fishing nets. Cotton yarn is also sometimes used for this purpose, for it is cheaper. An every day used fishing net made of *San* lasts for about three years, while a cotton-net gets impaired after it is used for two years, at the longest.

CHAPTER XLII

JUTE IN BACKERGUNGE

(Published in 1898)

Jute is cultivated throughout the district, except the tracts swamped by salt water, where it is grown on a very small scale in homestead lands only for the home consumption of the raiyats. According to the last jute forecast report, published in 1897 by the Agricultural Department, the normal area under jute in Backergunge is 6,400 acres only.

Classification and description.—There are several races of jute signified by different names in different places. They may be classified as follows:—

- (1) *Corchorus capsularis* :—
 - (a) *Bagi*—*Bangi*—*Cowpla*,
 - (b) *Raktabagi*—*Nileta*,
 - (c) *Sutpat*—*Pechi*.
- (2) *Corchorus olitorius* :—
 - (d) *Bagi*—*Bangi*—*Nileta*.

The varieties or races are distinguished by the colour of the stems of the plants. The colour of the plants (a) and (d) is light green. The plants of (b) are purple in colour, and the colour of (c) plants is reddish. I found there are two kinds of plants in each of (a) and (d). The petioles and the ribs of the leaves of the plants (a) and (d) are as green as the stems. But there are a few plants in (a) having their petioles and ribs of the leaves

reddish * and in (d) they are reddish or pinkish in the colour of the stalks, petioles and ribs.

The two principal species (i.e., *Corchorus capsularis* and *Corchorus olitorius*) differ from one another in fruits. *Corchorus capsularis* has round pods, while the pods of *Corchorus olitorius* are long. They also differ in the ways of cultivation. *Corchorus capsularis* can thrive well in water to the depth of about 2 to 3 cubits, while *Corchorus olitorius* does not. Consequently *Corchorus capsularis* is very largely cultivated in Eastern Bengal, which is affected more or less by inundation, and where the cultivation of *Corchorus olitorius* is limited. It is also peculiar that *Corchorus olitorius* cannot strike the soil on which it is cultivated so firmly as *Corchorus capsularis* does.

The *Sutpat* is decidedly inferior to other varieties in the length of the fibre, but the cluster of fibre around the pith of *Sutpat* (i.e., the bark) is thicker than that of the other three varieties. Therefore the yields of the fibres of all the varieties are nearly equal.

* The fibres of the two species of *Bagi* are bright in lustre, hence they are called *Bagi* or *Bangi* (perhaps

* It has been observed that some of the races having stems light-green and petioles reddish, change the colour of the stems to pinkish when old (as Amonia of Faridpur, Deswal of Serajgunj in part); but there are some (Dhupri of Faridpur, Bhadoya-white of Jalpaiguri, Deswal of Serajgunj in part) which do not do so. These two sorts of the plants have been arranged in this book under *C. capsularis* group (2), page 13. In *C. olitorius* no such plants as having reddish petioles on green stems are found. The same colour is contained by both parts of a plant.

from *banga* which is a provincial word 'for cotton meaning white) which seems to have been derived from *bak* (stork) pronounced as *bag* in Eastern Bengal. Both the species of *Bagi* are under cultivation in some villages where *Corchorus capsularis* is called *cowpla*, which might have been derived from *capor* (cloth, *cowpla*=having the quality of *capor* i.e., as white as *capor*).

Rakta Bagi means red *Bagi*. The plants are purple but produce white fibre. *Nileta*, from *nal* (red), diminutive of *nal* correctly speaking *lal*.

I am unable to give proper reasons for the name of *Sutpat*. *Sut* means thread. Does it mean the *pat* (jute) which yields thread (*sut*) * *Pechi*, meaning deformed, is attributed to plants which do not attain proper development. There is no doubt that this variety was under cultivation in Eastern Bengal before all other varieties were introduced. I am also unable to give satisfactory reasons why *Bagi* (*Corchorus olitorius*) is called in some places *Nileta*. With the exception of a few, the plants are not red (*nal*) in colour. It is probable that this name was given only to separate it from another variety of the same description (*Corchorus capsularis*, *Bagi*) which was first introduced. Where *Corchorus olitorius* was introduced before *Corchorus capsularis*, the latter is not called there *Bagi*, but *cowpla* as described above.

The opinion of the raiyats regarding the qualities of the varieties is not unanimous. The fibre of *Corchorus olitorius* is said by the majority of them to be the stronger but coarser. The colour of the fibre of this

species is a little yellow, which is very much liked by the *Kapali* class of Eastern Bengal who weave gunny bags. The bags of *Corchorus olitorius* bring higher price. The fibres of other varieties are sometimes kept wet for two or three days after washing to give them this peculiar colour. This process would give yellowish sparkling colour to the fibre of *Corchorus olitorius*. *Sutpal* is decidedly inferior to other varieties in the brightness of colour.

Hibiscus cannabinus (*Mestha* or *Mesot* i.e., *Deccan* or *Imbari* hemp, is also included in the jute in the market. It was largely cultivated a few years ago when *mahajans* offered higher price for it. Now the price for *Mestha* has much fallen off because the fibre is coarse. *Mestha* is generally more lengthy than *Corchorus* and easily stripped and washed.

The cause of inferiority.—Now I come to the main point of my enquiry. The inferiority of the Backergunge jute is due to the mode of preparation of the fibre and mainly to the conditions not favourable for preparing it.

Jute is chiefly steeped in four kinds of water, namely :—

(a) Stagnant <i>bheel</i> water.	(c) Running <i>bheel</i> water.
(b) Stagnant river water.	(d) Running river water.

The *bheel* water is called *kala jal* (black water), and the river water is *baga jal* (white water). *Kala jal* is so called because it looks black (*kala*) on account of the absence of silt. *Bheel* water is always clear and looks

black. *Baga jal* seems to have been also derived from *bag* (stork) which is white in colour. In fact, *baga jal* is light grey on account of a large admixture of clay carried off by the rivers of the district which are the branches of the Ganges (Padma). It is so called because the raiyats do not generally make any difference between white and light grey colours.

The fibre of the jute steeped in the "black water" gives it a glossy white colour while the colour of the jute steeped in *baga jal* is grey. The cause is simple. As explained above, the *baga jal* contains silts which deposit in the fibre of jute at the time of retting. This silt colours the fibre grey. The stagnant *baga* water, of course, gives jute a better colour because it does not contain much silt. In the case of "black water," whether running or stagnant, the colour of the jute is not affected. The steeping of jute in running water takes longer time in retting than in stagnant water. The constant washing of the bundles by running water prevents an earlier decomposition. It is also inconvenient in another point, namely, the bundles within several bundles are heaped together) ret earlier than the outside bundles. Thus if the retting of the bundles within is complete, the bundles around will remain underretted ; and if the outside bundles are properly retted, the inside bundles will be overdone. Raiyats generally take the heap away when the bundles within are considered to be fit for stripping. The fibre of the bundles around will be sticky and of bad quality. On the other hand, the

washing of the fibre after stripping should be made in running water instead of stagnant water, so that the refuse left after washing could be carried off immediately, leaving clean water for washing the remaining fibre.

The jute, steeped in clean stagnant water properly retted and washed in clean running water, is the best. The places having all these advantages are best suited to jute cultivation. The cause of the stickiness in jute in Backergunge and in other districts is mainly due to insufficient retting. Insufficient retting does not clear the gummy matter of the coat of the fibre. Raiyats sometimes prefer insufficient retting where the prices for the superior and inferior qualities are not much different. Sufficient retting causes some loss of the fibre at the top of a plant and washing of the fibre clears every refuse making the fibre lighter in weight. I have seen in some places in Bhola that the raiyats do not wash the fibre at all in order to make the fibre heavier.

Superior quality of jute is obtained in the *bheel* lands in the Gaurnadi police-station, and the medium quality is procurable in the *chars* where jute is steeped in ditch water, which is stagnant, although the ditch water becomes sometimes filthy and brownish in colour with decayed vegetation. The bad quality is seen in all places by the sides of rivers where it is steeped in running *baga jal*. It does not appear to me that brackish water has anything to do with the inferiority of the Backergunge jute; in fact there is no brackish water during the rains in the jute-growing tracts of Backergunge.

CHAPTER XLIII

IMPORTANT RACES OF JUTE

It was observed that there are some 'particular varieties or races which yield fibre of very good quality. Structure of soils and situation of lands have a great deal to do with the quality. The same variety yields fibres of different qualities in different places. Sandy loam is more adapted for jute crop than either clay or sandy soil as far as the quality is concerned. Clay soil is said to produce the heaviest outturn. Flood also affects the quality of the fibre. The colour of the fibre depends chiefly on the cleanness of the water of steeping and washing.

The races of jute, specimens of which were collected by me during 1899 and 1900 for the Reporter on Economic Products to the Government of India, are described as follows :--

RACES OF JUTE IN PABNA

No. 1.

Locality.—Sirajganj, Pabna.

Species.—*Corchorus capsularis*; locally called *Desal* (country).

Description.—Stem and leaf-stalk reddish (purplish or pinkish)

Outturn.—Five maunds per bigha.

No. 2.

Locality.—Sirajganj.

Species.—*Corchorus capsularis*. Also called *Desal*.

Description.—Stem light green ; leaf-stalk and fruits reddish.

These races of *Desal* are always cultivated together.

No. 3.

Locality.—Sirajganj.

Species.—*Corchorus capsularis*. Locally called *Kakya* or *Bombai* or *Kaskya* *Bombai*. *Bombai* is perhaps so called as this variety is longer than other varieties. The word *Bombai* (Bombay) is used in some places in Lower Bengal to denote some agricultural products which are larger in size. I could not ascertain what they mean by *Kakya*.

Description.—Stems, leaf-stalks and fruits are light green. It flowers about one month later than the *Desals*. Outturn is also more by 50 per cent. It grows in water better than the *Desal*. It can grow in water to the depth of 6 or 7 feet, but the *Desal* does not grow in water more than 3 or 4 feet in depth. Its bark (fibre) is thicker. Fibre is more glossy than that of *Desal*, but the fibre of *Desal* is finer than it. Raiyats like this variety most, because it is sold at higher prices than the other varieties. Seed of this variety is yearly indented from Assam. Most of the raiyats do not like to waste fibre of such quality by allowing the plants to seed. In future the Agricultural Department should indent the seed of this variety from Sirajganj for distribution specially in flooded districts.

No. 4.

Locality.—Sirajganj.

Species.—*Corchorus capsularis*. It is also called *Desal*.

Description.—Stem and leaf-stalk are light green as the former. The difference between *Desal* and *Kakya Bombai* is in the following respects :—

(a) Condition of the growth of the race No 3 is better.

(b) The outturn of *Kakya Bombai* in Sirajganj is 9 maunds, that of the *Desal*, is 8 maunds. *Nileta* variety, No. 5. yields 7 maunds per bigha, when they are all well grown.

(c) The *Desals* yield much more root fibres (adventitious roots) than the *Kakya Bombai*.

(d) The seed of the *Kakya Bombai* is a little smaller than that of the *Desals*.

No. 5.

Locality.—Sirajganj.

Species.—*Corchorus capsularis*. Locally called *Nileta*.

Description.—Stems and leaf-stalks are of purple colour. It flowers about a fortnight later than the *Desals*. It grows well on dry land, but can thrive also in water three feet deep. Bark is thinner than that of *Desal*. The colour of the fibre is more glossy than those of *Desals* and *Kakya Bombai*; hence it brings higher prices than the others.

No. 6.

Locality.—Sirajganj.

Species. — *Corchorus olitorius*. Locally called *Tosha*.

Description.—Stem, branches and leaf-stalk are of pink colour. It grows longer than the *Desals*. Fibre coarser and more yellowish ; hence it is sold at a lower price. It does not grow in water. It flowers about two months later than the *Desal*. Two seers of the seed of the *Desal* varieties are sown per bigha, while *Tosha* seed is sown at the rate of one seer per bigha. The yield of fibre of the *Tosha* variety is somewhat heavier than that of the *Desal* varieties, that is, if the *Desal* varieties produce 8 maunds per bigha, the *Tosha* will produce 10 maunds. It may be however noted that *Tosha* is always cultivated on better soils.

No. 7.

Locality. — Sirajganj.

Species.—*Corchorus olitorius*. Locally called *Bar-pata*, which means long (*bar*) jute (*pata* or *pat*).

Description.—Stem and leaf-stalk are light green. Flowers about a fortnight earlier than the *Tosha*. The colour of the fibre is yellowish ; less yellow than that of *Tosha*. Qualities and outturns of Nos. 6 and 7 are similar.

No. 8.

Locality.—Sirajganj.

Species.—*Corchorus olitorius*. It is also called *Tosha*.

Description.—Stem and leaf-stalk are slightly reddish. These specimens were collected from the field No. 6.

RACES OF JUTE IN MYMENSINGH

No. 1.

Locality.—Jagannathganj.

Species.—*Corchorus capsularis*. Locally called *Chhoran*, derived from the word *chhota* small). It is a dwarf and early variety.

Description.—Stem, leaf-stalk and fruits are green. Flowers in *Ashar*, and the fruits ripen in *Bhadra* and *Aswin*.

No. 2.

Locality.—Jagannathganj.

Species.—*Corchorus capsularis*. Locally called *Baran*, which means long (*Baro*).

Description.—Stem, leaf-stalk and fruits are of light green colour. It grows longer than the *Chhoran* variety, hence it is called *Baran*. Flowering and fruiting seasons begin later than the former variety. It produces fewer branches than the other. The outturn of the fibre of this variety is also heavier than that of the *Chhoran* variety.

No. 3.

* *Locality.*—Jagannathganj.

Species.—*Corchorus capsularis*. It is locally called *Kuchmadan* or *Nalpat* (red jute).

Description.—Stem, leaf-stalk and fruits are reddish. The fibres of the former two varieties are better than the fibre of this variety both in colour and quality. Flowering and fruiting time is the same as that of the *Baran* variety.

No. 4.

Locality.—Jagannathganj.

Species.—*Corchorus capsularis*. Called *Kamarjani*.

Kamarjani is a jute mart in Rangpur. The seed of this variety was perhaps first got from *Kamarjani*, hence it is called *Kamarjani*.

Description.—Stem, leaf-stalk and fruits light green. It is less branched and somewhat longer than the *Baran*.

It also produces better outturn than the *Baran* variety. It grows very well on dry land. This is one of the best varieties which I recommend for introduction into other districts. Flowering and fruiting seasons commence about one month later.

No. 5.

Locality.—Jagannathganj.

Species.—*Corchorus olitorius*.

Local names.—*Nileta*, *Talla*, *Barpata*, *Baran*. All these words mean the same thing, which is long. *Nileta* from *Nal* reed? *Talla* derived perhaps from one kind of bamboo which is called *Talla bans*. Originally this word (*Talla*) might have derived from the word *Taral* (*Tarala*, a Sanskrit word which means

liquid (light). This bamboo is much lighter than other bamboos.

Description.—Stem, leaf-stalk and fruits light green. Fruits get ripened in *Kartik* and *Aghran*. Outturn heavier than that of the former varieties.

No. 6.

Locality.—Jagannathganj.

Species.—*Corchorus olitorius*.

Local names.—*Nilcta*, *Talla*.

Description.—Stem and leaf-stalk pinkish. It is identical with the former in other respects.

RACES OF JUTE IN DACCA

No. 1.

Locality.—Narsingdi.

Species. —*Corchorus capsularis*.

Local names.—*Dhaleswari*, *Dhalsundar*. Both the words denote white plants.

Description. - Stem, leaf stalk and fruits light green. Flowers in July, and fruits ripen in September and October. It is the variety most commonly cultivated in this subdivision (Narayanganj). It is a good variety.

No. 2.

Locality.—Narsingdi.

Species.—*Corchorus capsularis*.

Local name.—*Parbatya*. This name might have

been derived from the word *parbat*, a hill. The seed might have first been obtained from some hilly place of Assam.

Description.—Stem, leaf-stalk and fruits pinkish ; growth luxuriant ; outturn heavier than that of the *Dhaleswari*. Fibre is also said to be better in quality and colour.

No. 3.

Locality.—Narsingdi, Dacca.

Species.—*Corchorus olitorius*.

Local name.—*Dewnallya*. Here *Nallya* denotes *Corchorus olitorius*. *Nallya* derived from *nal*, a reed.

Description.—The colour of the stem, leaf-stalk and fruits is light green. Flowers in September. Other particulars are the same as described of *Corchorus olitorius* in other districts.

No. 4.

Locality.—Narsingdi.

Species.—*Corchorus olitorius*.

Local names.—*Bangi, Nallya*.

Description.—Stem pink or light red ; branches and leaf-stalk are pinkish. Flowers in September. Fibre more yellow than that of the former.

No. 5.

Locality.—Narsingdi.

Species.—*Corchorus capsularis*.

Local name.—*Agniswar*, from *agni*=fire. Here it means that it has the colour like fire.

. *Description*.—Stem, branches and fruits all along pink ; leaf-stalk pinkish. Fibre is as good as *Parbatya*. Cultivation has been recently introduced.

No. 6.

Locality.—Narsingdi.

Species. *Corchorus capsularis*.

Local name.—*Desi, Desal*.

Description.—The colour of the stem, branches and leaf-stalk pinkish, like the colour of *Parbatya*. But the growth is not as good. It is now rarely cultivated.

RACES OF JUTE IN TIPPERA

No. 1.

Locality.—Chandpur.

Species.—*Corchorus capsularis*.

Local name—*Bidyasundar*.

Description.—Stem and leaf-stalk purple. Fruits purplish. It yields the finest and most glossy fibre of this place. Outturn 8 maunds per *bigha* (standard).

No. 2.

Locality.—Chandpur.

Species.—*Corchorus capsularis*.

Local name—*Dew Dholi*. *Dew* from *Dev*=a god, and *Dholi*=white. *Dew Dholi* means white like a god.

Description.—Stem, leaf-stalk and fruits light green. It is second to the former as regards quality. But the outturn is somewhat heavier, i. e., 10 maunds per standard *bigha*.

No. 3.

Locality.—Chandpur.

Species.—*Corchorus capsularis*.

Local name.—*Dhalsundar*, meaning white and beautiful.

Description.—Main stem light green; branches and fruits pinkish; yields heaviest outturn *i. e.*, 11 maunds per standard bigha. Fibre coarser than that of the *Dew Dholi*.

RACES OF JUTE GROWN IN FARIDPUR

Corchorus olitorius is always cultivated in high lands where there will be no flood water. In some places I have found them growing in water only to the depth of a few inches at about the time of harvest. It is sown in *Bysak* (middle of April to the middle of May). The yield per bigha is here about 7 maunds (sometimes 8 maunds). The raiyats are of the opinion that the fibre of *Corchorus olitorius* is stronger than the fibre of *Corchorus capsularis*. The bark of *Corchorus olitorius* is said to be thicker than that of *Corchorus capsularis*. The best fibre is obtained when the plants are just in flower in both the cases. The heaviest yield is obtainable when the fruits of the plants are mature. The *Bagipat* is not generally harvested before it bears fruit. Harvesting begins in *Sravan* (middle of July to middle of August), and continues up to the middle of *Aswin* (the end of September).

There are two methods in stripping jute fibre. They are as follow :—

(1) After the retting is complete, the plants are carried home. A plant is got hold of by the right hand of the stripper, who is generally a woman member of the family. She then pulls off the fibre by her left hand, and the stalk (wood) slides easily away. During this operation of the pulling off the fibre, she keeps her point finger between the fibre and the wood. One skilled woman can strip about 15 seers of dry fibre per diem.

(2) When the plants have retted, the raiyat stands by the retted heap of the plants. He takes up a handful of the plants which are broken at the distance of about 18 inches from the bottom. The broken pieces of woods are then thrown away. He now takes hold of the separated fibre at the bottom by both the hands, and pushes the plants up and down. After five or six pushes the fibre is cleared off. By this method one hard-working man can strip about 20 seers of fibre per diem.

In Faridpur both the methods are in vogue. In Madaripur and Sadar subdivisions, jute is stripped in the method (1) and in Goalundo in the method (2).

Deep, clear and stagnant water is preferred for steeping jute. They do not like to steep in running water, where it takes a longer time for retting.

Note on commercial specimens of Madaripur jute.

At the Madaripur market there are four kinds of jute, viz.—

(1) *Charua*,
(2) *Bagi*,

|

(3) *Bilan*, and
(4) *Buban*.

Charua belongs to the species *Corchorus capsularis*. It is grown on *char* lands on the sides of the rivers Padma and Arealkhan. Water to the depth of about two cubits accumulates on such lands during the months of *Sravan* and *Bhadra*.

The soil of these places may be described as a loam inclined to be sandy. These parts produce the best jute grown in the subdivision. It is steeped in deep stagnant river water. It is available in the market from *Sravan* to *Bhadra*. It was sold at the time of my visit at Rs. 4-8 per maund. This good quality of the fibre is said to be due to the soils where it is grown.

2. *Bagipat* (*Corchorus olitorius*).—It is grown on high lands and steeped in stagnant *bheel* water. Available in the market from *Bhadra* to *Aswin*. It is well known to the merchants that it is coarser than *Corchorus capsularis*, but its rope is said to be stronger than that made of the latter. Price was at Rs. 4-7 per maund. Soil on which it is grown is generally sandy loam. Out of the total quantity of jute available at the market of Madaripur, *Bagipat* shares only 12 per cent.

3. *Bilan* belonging to *bheel* belongs to the species *Corchorus capsularis*. Grown in *bheet* lands where water accumulates to the depth of about three cubits. All the varieties that are cultivated on low lands do not thrive much after inundation. It is steeped in stagnant *bheel* water. Available in the market from *Ashar* to *Aswin*. Price Rs. 4-4 per maund. Soil on which it is grown is clayey.

4. *Buban (eastern)*.—It is grown on *char* lands. Soil is similar to that on which *charua* is grown. It is steeped in shallow running river water (depth only $2\frac{1}{2}$ cubits). The mud of the river water deposits on the fibre during the time of retting which spoils the colour of the fibre. It was sold at Rs. 3-12 only per maund. It is available in the market from *Sravan* to *Bhadra*.

Note on commercial specimens of Pangsa jute

The following sorts of jute are sold at the Pangsa market :—

(1) <i>Pangsa</i> .	(3) <i>Padma paira</i> ,
(2) <i>Charua</i> .	(4) <i>Dakhina</i> , and
(5) <i>Farudpuri</i> .	

1. The *Pangsa* quality of jute is brought for sale to Pangsa from surrounding places. It is sold in the market from the middle of *Sravan* to *Kartik*. This sort of jute is cultivated on high lands which are composed of loamy soil. Steeped in clear water. The price was Rs. 3-5 per maund (1 seer = 60 tolas) There is not less than 10 per cent. moisture, generally 30 per cent. in the jutes which are sold at this market. It belongs mostly to the species *Corchorus capsularis*.

2. *Charua* is grown on *char* lands composed of a loam inclined to sands. It is steeped in stagnant river water slightly muddy. Available in the market from the middle of *Sravan* to *Kartik*. Price was Rs. 3-6 per maund. Generally the *Pangsa* and *Charua* are mixed together and sent to Calcutta for sale.

3. *Padma paira* is a sort of jute which comes from

the other side of the river Padma (e. g., Pabna). It is grown on *bheel* lands composed of clayey soil. It is more or less sticky and reddish. It is available in the market from *Bhadra* to *Kartik*. Price Rs. 3-4 per maund.

4. *Dakhina*--This sort of jute comes from the Balliakandi police-station. It is grown on *bheel* lands composed of clayey soil. It is steeped in stagnant clear water. Fibre is sticky. Available in the market from *Bhadra* to *Kartik*. Price Rs. 3-4 per maund.

5. *Fridpuri* sort of jute is brought from places in the police-stations of Ainpur and Bhanga. It is grown on *bheel* lands composed of heavy clay. The water in which it is steeped is more or less clear. Fibre is very sticky. Available in the market from *Sravan* to *Aswin*. Price Rs. 3 per maund.

Sometimes the localities where jute of good quality is obtained produce bad quality owing to the following reasons :--

Jute is sown from *Chaitra* to *Jaistha*. During the period of growth occasional showers of rain at intervals of about eight days are required for producing good quality, but heavy rains during this period (when the plants are young) are injurious. Hairy larvae (*Spilosoma*), locally called *salkit*, also attack the plants if there be heavy rains ; the plants become more branchy than usual, and yield sticky harsh fibre.

Best fibre is obtained from the plants which are harvested just in flowers. Early flood is therefore wanted by raiyats for harvesting (e. g., steeping) just in time.

Samples from Nos. 1 to 8 were collected in Madaripur, on the 11th and the 12th September 1900.

Faridpur No. 1.

Species.—*Corchorus capsularis*.

Local name—*Sutpat*.

Description.—Colour of the stem and half-stalk is pinkish. It flowers in the latter part of July. This variety is commonly cultivated in this part of the district because it can thrive well in deep water (not exceeding 3 cubits in depth). Fibre is generally sticky at the bottom. About 5 maunds of fibre is obtained from one bigha of land. It grows in deep water.

Faridpur No. 2.

Locality.—Habiganj, Madaripur.

Species.—*Corchorus capsularis*.

Local names.—*Desal* (country), *Peti* (small).

Description.—Stem light green when young. Branches, leaf-stalk and fruits are of reddish colour similar to No. 1. It is being cultivated for a long time. It is more branchy than other varieties. Grows in water to the depth of 5 feet. Yields 6 or 7 maunds per local bigha.

Faridpur No. 3.

Locality.—Habiganj, Madaripur.

Species.—*Corchorus capsularis*.

Local name.—*Udhap* (meaning perhaps white=*dhap*).

Description.—Stem, leaf-stalk and fruits light green.

Fruits larger than those of the *Desals*. Outturn 7 maunds per bigha (local).

Faridpur No. 4.

Species.—*Corchorus capsularis*.

Local name.—*Cowpla pat*.

Description.—All parts of the plant are light green in colour. It flowers in the latter part of July. It is grown on both high and low lands. Outturn is about 5 maunds per bigha, but the quality of the fibre is said to be better than that of *Sutpat*.

Faridpur No. 5.

Species.—*Corchorus capsularis*.

Local name.—*Lali* or *Ranga pat*.

Description.—The colour of the stem and the leaf-stalk is purple. Grown in both high and low lands. It flowers about a fortnight earlier than the varieties 3 and 4 mentioned above. Fibre is said to be finer but less in quantity.

Faridpur No 6.

Species.—*Corchorus capsularis*.

Local name.—*Belgachi*.

This variety has been newly introduced.

Description.—Stem, leaf-stalk and fruits are pinkish or reddish. It flowers in the latter part of July. Fibre is better than that of the *Sutpat*, both in quality and quantity.

Retting is finished in much shorter time. In June it

takes only 10 days for retting while Desal or Sutpat takes 15 days. In September it takes 15 days.

Faridpur No. 7.

Species.—*Corchorus olitorius*.

Local name.—*Dhala bagi*.

Description.—All parts of the plant are light green in colour. Generally sown in May. Outturn 8 maunds per local bigha (one bigha = 120×120 cubits = $\frac{3}{4}$ acre).

Faridpur No. 8.

Species.—*Corchorus olitorius*.

Local name.—*Lal, Nal or Rangabagi*.

Description.—All parts of the plant are pink in colour. No distinction is made between these two varieties of *Corchorus olitorius* regarding their cultivation, yield and quality.

The following 9 varieties were collected from Pangsa, a principal jute market in the Goalundo subdivision in Faridpur on the 15th and 16th September.

Faridpur No. 9.

Species. -*Corchorus olitorius*.

Local name.—*Satnala, Barpata, Dhamraj*.

Description.—Stem, leaves and pods are all light green in colour. Sown in *Chaitra* and *Bysak* on high lands. Seed sown, 1 seer (60 tolas) per *pakhi*. Flowers in *Bhadra*. Outturn per *pakhi* is 6 maunds to 7 maunds (1 *pakhi* = 10×12 nals, and 1 *nal* = $6\frac{1}{2}$ cubits = 8 standard Bengal bigha.) Harvested in *Bhadra*. It takes 12 days for rotting.

Faridpur No. 10.

Species.—*Corchorus olitorius*.

Local name.—*Meghnal*. It is also called *Bar pata* in some places.

Description.—Stem and leaf-stalks are of *pink* colour. Sown in *Chaitra* and *Bysak* at the rate of 1 seer (60 tolas) per *pakhi*. Flowers in the latter part of *Sravan*. Outturn per *pakhi* is about 6 maunds. The plants are a little shorter than the former. Harvested in *Bhadra*. It takes 12 days for retting. *Corchorus olitorius* grows always taller than *Corchorus capsularis*.

Faridpur No. 11.

Species. *Corchorus capsularis*.

Local name.—*Dhaleswari*.

Description.—Stem, leaf stalk and fruits are reddish in colour when old. It is sown in *Chaitra* and *Bysak* at the rate of 2 seers of seed per *pakhi*. Flowers early in *Sravan*. The bark is thinner than that of *Corchorus olitorius*. It may be grown on both high and low lands. Water accumulated on the low lands shou'd not be more than $1\frac{1}{2}$ cubits in depth. It takes about 15 days for retting.

Outturn.—Four to $4\frac{1}{2}$ maunds per *pakhi*.

Faridpur No. 12.

Species.—*Corchorus capsularis*.

Local name.—*Amunia*.

Description.—Stem, leaf-stalk and pods are light green in colour, and it does not branch much. Sown

on high lands in *Chaitra* and *Bysak*. Two seers of seed are required for one *pakhi*. Flowers in the latter part of *Bhadra*.

Outturn.—Six maunds per *pakhi*.

It takes about 12 days for retting. The fibre of this variety is the finest of all grown in this part of the district.

Faridpur No. 13.

Species.—*Cochchorus capsularis*.

Local name—*Shani*. Also called *Desal*, *Sodu* and *Kuch mardan*.

Description.—Stem, leaf-stalk and pods are reddish. Sown in *Chaitra* and *Bysak* on both high and low lands. Water on the lands here stands to the depth of about 3 to $3\frac{1}{2}$ cubits. Seed 2 seers (1 seer=60 tolas) per *pakhi*. Flowers early in *Ashar*.

Outturn.—Three to $3\frac{1}{2}$ maunds of fibre per *pakhi*.

It takes about one month for retting.

This variety is being cultivated in this place for a long time. Fibre is always sticky at the bottom. Plants are very strong and much branched. Its stripping is very difficult. Its cultivation is dying out.

Faridpur No. 14.

Species.—*Cochchorus capsularis*.

Local name.—*Dhapa*.

Description.—Stem, leaf-stalk and pods are reddish, identical with the former. But flowers in *Bhadra*.

Faridpur No. 15.

Species.—*Corchorus capsularis*.

Local name.—*Meghnal* (see No. 10).

Description.—Stem and leaf-stalk are of purple colour. Sown generally on low lands where water accumulates to the depth of about 2 cubits. One and three quarters of a seer (60 totals = 1 seer) of seed are required for one *pakhi*. Flowers in early *Bhadra*. It takes about 15 days for retting.

Outturn.—About 5 maunds per *pakhi*.

Faridpur No. 16.

Species.—*Corchorus capsularis*.

Local name.—*Kamarjani* (1). It is also called *Parbatya*.

Description.—Stem, leaf-stalk and pods are light green in colour. Sown generally on low lands in *Chaytra* and *Bysak*. Water may accumulate there to the depth of about $2\frac{1}{2}$ cubits. Two seers of seed (60 tolas = 1 seer) are sown per *pakhi*. Flowers in the latter part of *Sravan*. It takes about 20 days for retting.

Outturn.—Five maunds per *pakhi*.

Leaves of this variety are used here as a favourite pot-herb.

Faridpur No. 17.

Species.—*Corchorus capsularis*.

Local name.—*Kamarjani* (2).

Description.—Stem and leaf-stalk are reddish. Sown on the same kind of lands as selected for variety No. 16

* Seed—2 seers per *pakhi*. Flowers in the latter part of *Sravan*. Retting is finished within 15 days.

Outturn.—Five to 6 maunds per *pakhi*.

No. 18.

Locality.—Goalundo.

Species.—*Corchorus capsularis*.

Local name.—*Ghagri*. Could not trace why it is called *Ghagri*.

Description.—The colour of the stem, leaf-stalk and fruits is light green. Flowers in July; fruits ripen in September.

No. 19.

Locality.—Goalundo.

Species.—*Corchorus capsularis*.

Local names.—*Ghagri, Desal*.

Description.—The colour of the stem is light green, and that of the branches, leaf-stalk and fruits is reddish. Fruits a little smaller than those of the *Ghagri*.

No. 20.

Locality.—Goalundo.

Species.—*Corchorus capsularis*.

Local names.—*Lalpat* (red jute), *Kajla* (black), *Meghnal* ((*Megh*=cloud, and *Nal*=red, i. e., a colour mixed of blue and red).

* *Description*.—Stem, branches and leaf-stalk are pink. A tinge of violet colour on the fruits. Flowering season commences about 15 days later than *hatto*

Ghagni. It is less branched than the two *Ghagris*. As a pot-herb the leaves of this variety are better than the leaves of the other varieties.

No. 21.

Locality.—Goalundo.

Species.—*Corchorus olitorius*.

Local name.—*Bomi* (from *Bangi* or *Bagi*.)

Description.—The colour of the stem and leaf-stalk is light green. It flowers in July. It does not grow as tall as the *Satnala*, which is also a light green variety flowering later.

No. 22.

Locality.—Goalundo.

Species.—*Corchorus capsularis*.

Local name.—*Kamarjani*.

Description.—Stem, leaf stalk and fruits are similar to No. 17. Fibre is more glossy than that of the *Ghagris*. It is one of the best varieties recommended for introduction into other districts where it is not cultivated.

No. 23.

Locality.—Goalundo.

Species.—*Corchorus capsularis*.

Local name.—*Dhupri* (perhaps from *Dhubri*). A new variety.

Description.—Stem light green. Leaf-stalk and fruits are slightly reddish. Growth is more vigorous than that of other varieties of *Corchorus capsularis*. Flowering time begins some 15 days later than that of the *Ghagri*.

RACES OF JUTE GROWN IN RANGPUR

Rangpur No. 1.

Species.—*Corchorus olitorius*.

Local name.—*Parbati Madai*.

Description.—Stem and leaf-stalk are reddish in colour. There are two varieties of *Parbati pat*, viz., (1) red-stemmed and (2) white-stemmed. They are grown together.

Corchorus olitorius is sown during the months from *Falgun* to *Bysak*. In some places it is sown only in *Bysak*.

It is also grown on high lands. One seer (1 seer = 90 tolas) of seed is required for 1 *done* (1 *done* = 13 standard cottahs).

Soil.—Sandy loam.

Outturn.—Four maunds to five maunds per *done*.

Flowering season.—Latter part of *Aswin*.

It is harvested when the plants are in flowers. In the case of urgency it is harvested just before the flowering time, but the yield per *done* would be only 3 maunds instead of 4 maunds.

Ten to 15 days are required for retting.

It is said to be stronger but coarser than *Corchorus capsularis*.

It is only cultivated for home consumption, which may be roughly estimated at 3·5 per cent.

The price of the fibre of *Corchorus olitorius* is about 50 per cent. less than that of *Corchorus capsularis*.

Rangpur No. 2.

Species.—*Corchorus capsularis*. (*Capsularis* is generally called here *Jati pat*.)

Local name.—*Dhala Ausa*. (*Dhala* means white, and *Ausa* is a crop which is harvested earlier than the *Hewta* from the word *Hementa* the autumn season.)

Description.—Stem is light green, but branches and leaf-stalk are reddish. Sown from *Falgun* to *Bysak*. **Seed**—One seer per *done*.

Soil.—Both high and low lands; they prefer "clayey soil," but which is nothing but a loam.

Flowering season.—Latter part of *Sravan*.

Harvested in flowers and also in fruits.

Outturn.—Four maunds per *done*.

Rangpur No. 3.

Species.—*Corchorus capsularis*.

Local name.—*Lal Ausa*. Also called in some places *Meghnal*.

Description.—Stem, leaf-stalk and fruits are purple in colour. In other respects than its yield of fibre, which is said to be a little less, *e. g.*, about $3\frac{1}{2}$ maunds per *done* instead of 4 maunds, it is similar to No. 2.

Rangpur No. 4.

Species.—*Corchorus capsularis*.

Local name.—*Lal Hewta*; in some, places *Meghnal*.

Description.—The colour of stem, etc., is less purple than that of *Lal Ausa* (No. 3.)

Sowing time.—Falgun to Bysak.

Flowering time.—Latter part of Bhadra.

Regarding the outturn, the opinion of some raiyats is that the *Hewta* variety yields heavier than the *Ausa* variety (about half a maund heavier per *done*) ; but others are of the opinion that the yields of the *Ausa* and the *Hewta* varieties are equal. Some raiyats stated that the fibre of the *Hewta* variety is more glossy than that of *Ausa*.

Regarding soil, cultivation, etc., it is similar to the *Ausa* variety.

Rangpur No. 5.

*Species.—**Cochchorus capsularis*.

*Local name.—**Dhala Hewta*.

*Description.—*Stem and leaf-stalk are light green in colour. In other respects it is similar to the variety No. 4, *Lal Hewta*. But it is stated that the white-stemmed variety yields a little heavier outturn than the red-stemmed variety. The red-stemmed variety is said to produce finer fibre.

In Rangpur the raiyats prefer running water for steeping jute, because this water carries away all dirty substances from the heap of plants, although they are aware that it takes longer time for retting. Best colour of the fibre is said to be produced if retted in such water. Jute is stripped in this district in the method No. 2 described in page 162.

RACES OF JUTE IN JALPAIGURI

No. 1.

Locality.—Alipur Duars.

Date.—22nd September 1900.

Species.—*Corchorus capsularis*.

Local name.—*Dhala Betre*.

Description.—All parts of the plant are light green in colour.

No. 2.

Locality.—Alipur Duars.

Date.—22nd September.

Species.—*Corchorus capsularis*.

Local name.—*Dhala Betre*.

Description.—Stem is of light green colour, but branches and leaf-stalks are slightly reddish.

No. 3.

Locality.—Alipur Duars.

Date.—22nd September.

Species.—*Corchorus capsularis*.

Local name—*Lal Betre*. It is also called *Parbatya*.

Description.—Stem and leaf-stalk are of purple colour.

General note on the Betre Races of Jute found in Alipur Duars in Jalpaiguri.

They are sown on high lands which are composed of sandy loam.

Two seers of seed are sown per done (1 done

is equal nearly to 1 standard bigha). It is sown from the 15th of *Chaitra* to the 15th of *Bysak* (i.e., April). They flower early in *Sravan*. Harvested when the plants are in flowers or in fruits. The raiyats are of the opinion that the harvesting of the plants in flowers is easier and less expensive, while the plants harvested in fruits produce a little heavier outturn of fibre. In stagnant water retting is complete within a fortnight, while in running water it takes about a month. Still running water is preferred because it gives good colour to the fibre.

Yield is said to be only 3 maunds per *done*.

No. 4.

Locality. —Alipur Duars.

Date.—22nd September.

Species.—*Corchorus capsularis*.

Local name.—*Hewti*.

Description.—All parts are light green. It flowers in *Aswin*. Fibre is said to be finer than that of the *Betre*. Extracting of fibre is considered to be easier because *Hewti* is less branched than the *Betre*. In other respects it is similar to *Betre*.

Corchorus olitorius is not cultivated in the Alipur subdivision.

No. 5.

Locality.—Jalpaiguri.

Date.—26th September.

Species.—*Corchorus capsularis*.

Local name.—*Sada Bhadoya* (white early).

Description.—Stem is light green, but leaf-stalk and fruits are slightly reddish. Sown in the months of *Chaitra* and *Bysak* on both high and low lands which are composed of sandy loam. It flowers early in *Sravan*. Harvested when the plants are in flowers or in fruits.

Outturn.—Four maunds per *done*.

No. 6.

Locality.—Jalpaiguri.

Date.—26th September.

Species.—*Corchorus capsularis*.

Local name.—*Lal Bhadoya*.

Description.—All parts are of purple colour. *Lal pata* (red variety) is said to be better in colour and quality than the *sada pata* (white variety). In other respects it is similar to variety No. 5.

No. 7.

Locality.—Jalpaiguri.

Date.—27th September.

Species.—*Corchorus capsularis*.

Local name.—*Sada* (white) *Hewti*.

Description.—All parts of the plant are light green. It flowers early in *Bhadra*. It is a late variety. The early varieties (Nos. 4 and 5) are said to yield better and heavier fibre. The bark of the plant of this variety is said to be thinner than that of the early varieties. In other respects it is similar to the early varieties. Early varieties take 15 days for retting, while late varieties take 20 days.

No. 8.

Locality.—Jalpaiguri.

Date.—27th September.

Species.—*Corchorus capsularis*.

Local name.—*Hewti lal-pata* (late red variety).

Description.—Stem, leaf-stalk and fruits are of purple colour.

No. 9.

Locality.—Jalpaiguri.

Date.—27th September.

Species.—*Corchorus capsularis*.

Local name.—*Hewti lalpata* (late red variety).

Description.—Stem, leaf-stalk, etc., are of slightly purple colour or pinkish. It was collected from the field No. 8.

No. 10.

Locality.—Jalpaiguri.

Date.—27th September.

Species.—*Corchorus olitorius*.

Local names.—*Marua pata, Bomochak*.

Description.—Stems and leaf-stalks are of purple colour. It flowers early in *Bhahra*. It is cultivated on a very small scale, usually for using the leaves as a pot-herb. It is stated that dried leaves of *Corchorus capsularis* are more efficacious in medicines. The leaves of *Corchorus olitorius* are little bitter to taste, hence it is more palatable.

*The fibre of this variety is never available in markets.

In Jalpaiguri, jute is stripped in the method (2) described already.

CHAPTER XLIV

THE RACES OF JUTE CULTIVATED ON THE BURDWAN FARM IN 1902

Plot No. 1.

Species.—*Corchorus capsularis*.

Race.—*Baran*, from Jagannathganj, Mymensingh.

Description.—The stem and petioles of the plants are light green in colour. On 23rd August 1902 about 2 per cent. of the plants were found flowering. The latest of all the eleven varieties of *Corchorus capsularis* cultivated on the Farm. Not much branched. The length of the highest plant was 12' 0".

Plot No. 2.

Species.—*Corchorus capsularis*.

Race.—*Barapat*, from Jagannathganj, Mymensingh.

Description.—Stem and petiole light green. On the 20th August 30 per cent. of the plants found flowering. Not much branched. The length of the highest plant was 11' 5".

Plot No. 3.

Species.—*Corchorus capsularis*.

Race.—*Kakya Bombai*, from Sirajganj, Pabna.

Description.—Stem and petioles light green. On 26th August 10 per cent. of the plants found flowering. Not much branched. The length of the highest plant was 10' 9".

Plot No. 4.

Species.—*Corchorus capsularis*.

Race.—*Desal*, from Sirajganj, Pabna.

Description.—*Desal* is a mixture of two kinds of plants which are never separately cultivated where the seed has been received from. One sort has the stem and leaf-stalk of light green colour, while the other has the stem of light green colour, and the colour of the petiole is purplish. On the 20th August 10 per cent. of the plants found flowering. Not much branched. The length of the highest plant was 11' 0".

Plot No. 5.

Species.—*Corchorus capsularis*.

Race.—*Barapat*, from Sirajganj, Pabna

Description.—The stem and petiole are of light green colour, similar to No. 3. On the 20th August 30 per cent. of the plants found flowering. The length of the highest plant was 10' 8".

Plot No. 6.

Species.—*Corchorus capsularis*.

Race.—*Naitta*, from Sirajganj, Pabna.

Description.—Stem and leaf-stalk are purple. On the 20th August 10 per cent. of the plants found flowering. Strong and not much branched. The length of the highest plant was 9' 8".

Plot No. 7.

Species.—*Corchorus olitorius*.

Race.—*Tosha*, from Sirajganj, Pabna.

Description.—Stem and petiole of the plants are more or less pink in colour. On the 19th September 20 per cent. of the plants found in flowers, producing only a few branches at the top. Very late. The length of the highest plant was 11'.

Plot No. 8.

Species.—*Corchorus olitorius*.

Race.—*Satnala*, from Rajbari, Faridpur.

Description.—The stem and petiole of the plant light green. Came into flower about 20th July. An early variety, branching irregularly at the top. The length of the highest plant was 11'.

Plot No. 9.

Species.—*Corchorus capsularis*.

Race.—*Nalpat* or *Meghnal*, from Rajbari in Faridpur.

Description.—Stem and petioles purple in colour. On the 20th August 20 per cent. of the plants found flowering. It is similar to No. 6. The length of the highest plant was 9' 8".

Plot No. 10.

Species.—*Corchorus capsularis*.

Race.—*Amonia* from Pangsa, Faridpur.

Description.—Stems light green when young afterwards purplish and petioles purplish. On the 20th August 2 per cent. of the plants found in flowers. A late variety; very strong and branched. It appears that it is not true *Amonia* as described in my notes of 1900. The length of the highest plant was 9' 7".

Plot No. 11.

Species.—*Corchorus capsularis*.

Race.—*Kamarjani*, from Pangsa, Faridpur.

Description.—Stems light green at first; but purplish when older. Petioles purplish. On the 20 August 1 per cent. of plants found in flowers. A late variety;

not much branched. It is similar to No. 10. The length of the highest plant was 10' 0".

Plot No. 12.

Species.—*Corchorus olitorius*.*

Race.—*Desi lalpat*, from Serampore, Hooghly.

Description.—Stem and petiole are pink in colour. On the 19th September 26 per cent. of the plants were in flowers. The length of the highest plant was 12'.

Plot No. 13.

Species.—*Corchorus olitorius*.

Race.—*Bangi*, from Narsingdi, Dacca.

Description.—Stems and petioles light green. The length of the highest plant was 10' 7". It is similar to No. 8.

Plot No. 14.

Species.—*Corchorus capsularis*.

Race.—*Dhaleswar*, from Narsingdi, Dacca.

Description.—Stem and leaf-stalk light green. On the 20th August 1 per cent. of plants found in flowers. The length of the highest plant was 10' 9". It is similar to No. 3.

Plot No. 15.

Species.—*Corchorus capsularis*.

Race.—*Belgachi*, from Madaripur, Faridpur.

Description.—There is a tincture of purple colour in the stems and petioles. A late and strong variety branching freely at the top. The length of the highest plant was 9' 6".

* In the neighbourhood of Calcutta *Corchorus capsularis* is called *Lankagoya pat*.

CHAPTER XLV

A LIST OF THE IMPORTANT RACES OF JUTE

Name.	District where grown.	Name.	District where grown.
<i>C. capsularis.</i>		<i>C. capsularis.</i>	
Aus.	... Mymensingh	Kamarjani	... Faridpur.
Baran	...	Kuchmardan	...
Bara pat	..."	Lali	..."
Boran	..."	Meghnal	..."
Chhoran	..."	Nal pat	..."
Chhota pat	..."	Peti	..."
Kamarjani	..."	Ranga pat	..."
Kuchmardan	..."	Sut pat	..."
Nal pat	..."	Shami	..."
Parbatia	..."	Sodu	..."
Agniswar	... Dacca.	Udhap pat	..."
Belgachi	..."	Bagi	... Backergunge
Bidya sundar	..."	Bangi	..."
Desal	..."	Cowpla	..."
Desi	..."	Nileta	..."
Desi Nallya	..."	Pechi	..."
Dhaleswari	..."	Rakta Bagi	..."
Dhal sundar	..."	Sut pat	..."
Kajla	..."	Bidya sundar	... Tippera.
Parbatia	..."	Deo dhal	..."
Amonia	... Faridpur.	Dhal sundar	..."
Belgachia	..."	Meghnal	..."
Cowpla	..."	Phuleswari	..."
Desal	..."	Bara pata	... Pabna.
Dhaleswari	..."	Bombai	..."
Dhapa	..."	Deswal	..."
Dhupri	..."	Kakya	..."
Ghagri	..."	Kakya Bombai.	..."
Kajla	..."	Nalita	..."

NAME.	District where grown.	NAME.	District where grown.
<i>C. capsularis</i>		<i>C. capsularis</i>	
Ausa ...	Rangpur	Betre ...	Jalpaiguri
Bhadoya ...	"	Bhadoya ...	"
Hewta ...	"	Hewti ...	"
Hewti ...	"	Lalpata ...	"
<i>Corchorus olitorius</i>			
Baran ...	Mymensingh	Bara pata ...	Faridpur
Bar pata ...	"	Dhala Bagi ...	"
Nileta ...	"	Dhamraj ...	"
Packnallya ...	"	Meghnal ...	"
Talla ...	"	Nal Bagi ...	"
Banghi ...	Dacca	Ranga Bagi ...	"
Banghi nallya	"	Satnala ...	"
Deo nallya ...	"	Parbatimadai	Rangpur
Bagi ...	Faridpur	Bomochak	Jalpaiguri
Bami ...	"	Marua pata	"

CHAPTER XLVI

A THOUSAND BIGHA JUTE FARM*

(Receipts and Expenditure)

RECEIPTS : -

6,000	maunds of jute at Rs. 8 per maund †	42,000
	(6 maunds per bigha)	
2,000	" of paddy at Rs. 2 per maund	4,000
1,000	" of mustard at Rs. 4 per maund	4,000
15,000	" of <i>pekti</i> (stalks) at about 2'3 per maund (15 maunds per bigha)	2,000
2,000	" of paddy straw at 4 annas per maund	500
400	" Juar plants for fodder	500
		—
		Rs. 53,000

* Jute, paddy and rape or mustard are the only three crops recommended for a jute farm.

† Rs. 7 is the lowest price per maund of a good quality in this season..

EXPENDITURE

Establishment—

Salary of Supdt. at Rs. 200 per mensem	2,400
,, ,, First Assistant at 40 - per mensem	480
,, ,, Second Assistant at 25 - per mensem	300
two peons at 8 - per mensem	192
	<hr/>
	3,372

Initial Expenditure —

Cleaning and plotting lands	...	10,000
120 bullocks at Rs. 30 each	...	3,600
10 Iron ploughs (Meston's or Ward & Co's "Climax")	...	50
70 Yokes	...	35
10 Bidas	...	60
4 Five tined grubbers	...	40
4 Hengas (beam harrow)	...	20
6 Ladders	...	3
2 Chaff cutters	...	300
1 Scale	...	10
200 Sickles	...	50
200 Khurpis	...	25
60 Kodali	...	45
10 Carts	...	400
1 Cake crusher	...	100
Tin roofed cowshed	...	3,000
Straw shed for servants	...	500
Tin roofed godown	...	3,000
Superintendent's quarters	...	1,000
Office and store rooms	...	1,500
Miscellaneous	...	262
	<hr/>	24,000

Recurring Expenditure—

50	Country ploughs	...	150
60	Ploughmen at 8 - per mensem	...	5,760
10	Sirdar coolies at 10 - per mensem	...	1,200
6	Servants for feeding and grazing cattle	576	
200	Extra coolies for 6 months for weeding, cutting, stripping &c.	..	9,600
200	Extra coolies for 10 days for trans- planting 500 bighas of land with paddy after cutting jute	...	500
50	Extra coolies for 20 days for cut- ting paddy	...	250
100	Extra coolies for 20 days for thrashing paddy	...	500
100	Extra coolies for 10 days for thrashing mustard	...	250
1095	Maunds of oil cake for bullocks at 3 mds. per diem	...	1,642
36	Mds. of salt for bullocks	...	90
2000	Mds. of paddy straw	...	500
4000	Mds. of juar plants	...	500
50	Mds. of jute seed	...	500
62	Mds. of seed paddy	...	186
25	Mds. of seed mustard	...	150
	Depreciation on bullocks and implements	...	600
	Rent * at Re. 1 - per bigha	...	1,100
	Miscellaneous	...	946
			<u>25,000</u>
	Net profit (on a capital say Rs. 35,000)	...	28,000

One hundred additional bighas of land required for compounds and grazing grounds.

CHAPTER XLVII

PREPARATION OF KEROSENE EMULSION

SOAP FORMULA

Kerosene	...	...	...	2 gallons.
Fish-oil-soap (or 1 quart soft soap)			...	½ lb.
Water	...	...	...	1 gallon.*

The soap, cut into small pieces, is to be dissolved in the water by boiling and immediately added, away from the fire, to the kerosene oil. The whole mixture is then agitated violently while hot with an ordinary butter churn used in this country. The emulsion should be ready after 5 or 6 minutes agitation, when it would assume the consistency of cream. The emulsion should be diluted with water when it is to be used. If fish-oil-soap or soft-soap (potash soap) be not available ordinary bar soap may be used.

* In the up country, where the water is hard, some of the soap will combine with the lime or magnesia in the water, and more or less, the oil will be freed, especially when the emulsion is diluted. Such water should be broken with lye, or rain water employed. It would be better to follow the "milk emulsion" formula, with which the character of the water whether hard or soft, does not affect the result.

MILK FORMULA.

Kerosene	...	...	...	2 gallons.
Sour milk	...	...	...	1 gallon.

The oil and sour milk are to be mixed together and churned as in the former case. After about 5 minutes

agitation the change from a watery liquid to a thick buttery consistency takes place which is thicker than that with the soap. Sweet milk may also be used for the sour milk after a little vinegar is added to it. Milk emulsion cannot be stored for a long time. It would be better to prepare it when required.

The Emulsion is to be diluted.

For the soft bodied insects and plant lice, one part of the emulsion is to be diluted with from 10 to 15 parts of water ; for the spider and other plant mites the same, with the addition of 1 ounce of flowers of sulphur to a gallon. For scale insects, the larger plant bugs, larvæ and beetles, dilute it with from 7 to 9 parts of water.

APPENDIX I.

STATEMENT SHOWING AREA AND YIELD OF RICE IN INDIA
AND EXPORT.

YEAR	Area under Rice in acres.	Yield of rice cwt. (husked).	EXPORT OF RICE CWT.	
			Unhusked.	Husked.
1891-92	49,539,031	314,804,161	427,048	32,739,881
1892-93	48,358,707	420,282,625	542,812	27,395,513
1893-94	49,525,300	459,119,400	627,983	24,019,924
1894-95	50,002,241	497,901,780	580,063	33,721,528
1895-96	49,396,747	415,355,100	516,162	34,635,624
1896-97	48,021,462	275,676,100	454,015	27,820,322
1897-98	52,205,466	498,350,700	474,564	6,272,097
1898-99	52,682,050	505,640,600	549,482	37,392,804
1899-1900	51,969,635	451,553,460	408,847	31,862,546
1900-01	48,932,493	413,506,700	277,093	30,065,695
1901-02	48,511,190	384,294,100	286,998	33,741,841
1902-03	51,842,390	469,484,800	451,062	47,033,137
1903-04	49,461,465	439,280,700	560,565	44,441,186
1904-05	51,586,900	448,461,100	613,075	48,834,548
1905-06	54,428,600	433,138,300	828,745	42,208,473
1906-07	54,521,600	430,258,400	655,132	38,048,709

APPENDIX II.*

STATEMENT SHOWING AREA AND YIELD OF WHEAT IN INDIA
AND EXPORT.

YEAR.	Area under wheat in acres.	Yield tons.	EXPORT.	
			Wheat cwt.	Wheat flour. -cwt
1891-92	27,032,772	6,093,741	10,303,425	...
1892-93	27,759,158	7,649,105	14,973,459	...
1893-94	28,716,735	7,268,982	12,156,551	...
1894-95	28,421,851	6,998,930	6,887,791	...
1895-96	24,071,320	5,380,342	10,002,912	...
1896-97	20,579,727	5,303,289	1,910,553	590,791
1897-98	24,537,775	7,208,384	2,392,607	505,283
1898-99	25,370,078	6,837,674	19,520,496	682,662
1899-1900	18,687,782	5,357,142	9,704,087	557,894
1900-01	23,864,550	7,093,529	50,021	497,346
1901-02	23,446,161	6,090,524	7,321,818	529,328
1902-03	23,395,277	7,971,446	10,292,150	718,677
1903-04	28,413,743	9,641,145	25,911,312	810,422
1904-05	28,470,200	7,582,040	43,000,502	1,031,495
1905-06	26,357,400	8,579,140	18,750,467	899,056
1906-07	29,488,900	8,447,840	16,037,040	818,461

APPENDIX III.

STATEMENT SHOWING AREA AND YIELD OF RICE IN BENGAL
AND EASTERN BENGAL INCLUDING ASSAM SINCE 1895-96.

YEAR.	Area under rice in acres.	Yield cwt.
1891-92	39,552,008	284,804,161
1892-93	37,324,907	333,965,225
1893-94	37,886,500	374,227,800
1894-95	38,639,500	416,857,200
1895-96	37,447,600	317,514,600
1896-97	36,177,400	179,637,400
1897-98	39,549,500	398,142,000
1898-99	39,605,400	405,842,900
1899-1900	39,490,500	357,956,360
1900-01	36,013,900	311,508,600
1901-02	35,094,800	272,201,900
1902-03	37,553,700	358,977,300
1903-04	34,931,500	316,669,700
1904-05	38,355,200	347,229,100
1905-06	41,110,800	329,365,100
1906-07	40,612,000	317,938,300

APPENDIX IV.
 STATEMENT SHOWING NORMAL RAINFALL (FROM MARCH TO SEPTEMBER)
 IN JUTE DISTRICTS DURING JUTE GROWING SEASON.

District.	March.	April.			May.	June.	July.	August.	September.
		Inches.	Inches.	Inches.					
Burdwan ...	1'06	1'88	5'08	10'15		12'25	11'76	8'40	
Midnapore ..	1'13	1'54	5'39	10'23		12'43	12'82	9'61	
Hoogly ...	1'28	2'07	5'50	10'28		12'02	12'53	8'83	
Howrah ...	1'02	1'64	5'27	10'93		11'53	11'40	9'45	
24-Parganas	1'29	1'73	5'49	10'89		12'98	13'29	10'04	
Nadia ...	1'48	2'82	6'72	10'00		10'36	10'96	8'48	
Murshidabad	0'90	1'65	5'13	10'15		10'90	10'45	9'35	
Jessore ...	1'81	3'30	7'13	11'69		10'64	10'67	8'45	
Khulna ...	1'49	2'61	6'45	12'77		13'10	12'32	9'55	
Bhagalpur ..	0'44	0'90	3'15	8'34		12'72	11'66	10'19	
Purnea ...	0'49	1'57	5'41	12'61		18'16	14'98	15'44	

Cuttack ...	1.17	1.27	4.23	0.71	18.89	12.77	10.19
Balasore ...	1.49	1.79	5.06	9.10	12.06	11.85	12.13
Jalpaiguri...	1.69	5.91	14.31	26.77	33.16	26.60	22.90
Rangpur ...	1.03	3.19	10.22	17.05	14.80	12.58	14.10
Dinajpur ...	0.72	1.74	6.21	13.78	16.17	12.41	13.03
Malda ...	0.58	1.11	4.54	10.11	12.91	11.07	11.54
Rajshahi ...	0.95	1.78	6.04	10.53	11.81	10.39	10.50
Pabna ...	1.38	3.13	7.60	11.49	11.06	11.04	9.49
Bogra ...	1.02	2.40	7.91	12.83	13.26	11.48	10.95
Mymensingh	1.87	4.31	11.30	17.90	16.48	14.96	12.73
Dacca ...	2.43	4.76	9.61	12.64	12.95	12.59	9.05
Faridpur ...	2.26	3.89	8.37	12.45	11.71	11.49	8.28
Backergunj	1.64	2.7	9.58	17.37	17.45	16.21	11.35
Tippera ...	2.95	5.22	10.20	14.58	13.39	12.80	9.40
Noakhali ...	2.90	4.33	10.55	22.21	24.02	23.92	14.15

